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ABSTRACT

Presented are the findings of a national health examination survey of uncorrected and corrected monocular and binocular visual acuity of 7,514 noninstitutionalized youth 12 to 17 years of age analyzed with respect to age, sex, race, geographic region, size of place of residence, and annual family income. Among findings reported are that 70 0/0 of the youths had at least normal unaided binocular distance acuity, that four percent of the sample were unable to read at the 20/200 level unaided, that boys had better binocular distance acuity than girls, the 34 0/0 of the sample were reported to wear glasses or contact lenses, that Negro adolescents had better unaided visual acuity than white adolescents, that the prevalence of normal unaided acuity was greatest in the South, and that youths from families with income of less than $3,000 per year had better unaided visual than youths from families with incomes of $5,000 or more. Detailed tables supporting the findings are given. (DB)

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VITAL and HEALTH STATISTICS
DATA FROM THE NATIONAL HEALTH SURVEY
Series 11-Number 127

NATIONAL CENTER FOR HEALTH STATISTICS
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Visual Acuity of Youths 12-17 Years United States

U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service
Health Services and Mental Health Administration

Series 11 reports present findings from the National Health Examination Survey, which obtains data through direct examination, tests, and measurements of samples of the U.S. population. Reports 1 through 38 relate to the adult program, Cycle I of the Health Examination Survey. The present report is one of a number of reports of findings from the children and youth programs, Cycles II and III of the Health Examination Survey. These latter reports from Cycles II and III are being published in Series 11 but are numbered consecutively beginning with 101. It is hoped this will guide users to the data in which they are interested.

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Series 11
Number 127

Visual Acuity of Youths 12-17 Years United States

Uncorrected and corrected monocular and binocular visual acuity findings for U.S. youths 12-17 years of age by age, sex, race, region, size of place of residence, and family income.

DHEW Publication No. (HSM) 73-1609

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

Health Services and Mental Health Administration
National Center for Health Statistics
Rockville, Md. May 1973

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In accordance with specifications established by the National Health Survey, the Bureau of the Census, under a contractual agreement, participated in the design and selection of the sample, and carried out the first stage of the field interviewing and certain parts of the statistical processing.

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VISUAL ACUITY OF YOUTHS

Jean Roberts and David Slaby, *Division of Health Examination Statistics*

INTRODUCTION

Contained in this report are the uncorrected and corrected monocular and binocular visual acuity levels of youths 12-17 years of age in the noninstitutional population of the United States, as estimated from the Health Examination Survey findings of 1966-1970. Findings have been analyzed with respect to age, sex, race, geographic region, size of place of residence, and annual family income differentials.

The Health Examination Survey, in which these data were obtained, is one of the major programs of the National Center for Health Statistics, authorized under the National Health Survey Act of 1956 by the 84th Congress as a continuing Public Health Service activity to determine the health status of the population.

In carrying out the intent of the National Health Survey,[1] three different programs are used. The Health Interview Survey, which collects health information from samples of people by household interview, is focused primarily on the impact of illness and disability within various population groups. The Health Resources programs obtain health data as well as health resource and utilization information through surveys of hospitals, nursing homes, and other resident institutions and the entire range of personnel in the health occupations. The Health Examination Survey, on which the data in this report are based, collects these health data by direct physical examination, tests and measurements performed on samples of the population. The latter program provides the best way of obtaining actual diagnostic data on the prevalence of medically defined illnesses. It is the only one of the National Center for Health Statistics programs to secure information on unrecognized or undiagnosed conditions as well as on a variety of physical, physiological, and psychological measures within the population. It also collects medical history, demographic and socioeconomic data on the sample population under study with which the examination findings for these persons may be interrelated.

The Health Examination Survey is conducted as a series of separate programs, called cycles, each of which is limited to some specific segment of the United States population and to specific aspects of health. During the first cycle in 1960-1962 the prevalence of certain chronic diseases and the distribution of various physical and physiological measures were determined among a defined adult population, as previously described.[2,3]

The target population for the second cycle in 1963-1965 was the Nation's noninstitutionalized children 6-11 years of age. For it the examination focussed primarily on health factors related to growth and development as described in an earlier report.[4]

For the third cycle, on which the findings in this report are based, a probability sample of the noninstitutionalized youths 12-17 years of age in the United States was selected and examined. As in the preceding children's program, the one for youths was also designed to obtain basic measures of growth and development as well as data on other health characteristics for this segment of the population. The questionnaires and examination content and pro-

cedures were similar to those in the children's program, so as to obtain comparable information for the entire continuum of childhood through adolescence, but were supplemented, as necessary, to obtain data specifically related to adolescent health. Included were physical examination given by a pediatrician assisted by a nurse, examination by a dentist, tests administered by a psychologist, and a variety of tests and measurement by laboratory X-ray technicians. The survey plan, sample design, examination content, and operation of this survey program have been described in a previous report.[5]

Field collection operations for the youths' cycle started in March 1966 and were completed in March 1970. For this program 7,514 youths were selected in the sample; 6,768 or 90 percent, were examined. This national sample and the examined group are closely representative of the 22.7 million noninstitutionalized youths 12-17 years in the United States with respect to age, sex, race, region, population size of place of residence, and rate of population change in size of place of residence from 1950 to 1960.

In this survey program, as in the preceding one among children, examinations were conducted consecutively in 40 different locations throughout the United States. Each youth, during his single visit, was given a standardized examination by the examining team in the mobile units specially designed for use in the survey. The only exception was that the girls whose urine specimens were found positive for bacteriuria were brought back for repeat urine tests. Prior to the examination, demographic and socioeconomic data on household members as well as medical history, behavioral, and related data on the youth to be examined were obtained from his parents. In addition a Health Habits and History form was completed by the youth before he arrived for the examination, and a Health Behavior form was completed by him while in the examination center. Ancillary data were requested from the school attended by the youth including his grade placement, teacher's ratings of his behavior and adjustment, and health problems known to his teacher. A birth certificate was obtained for each youth to verify his age and provide information related to his condition at birth.

Statistical notes on the survey design, reliability of the data, and sampling and measurement error are shown in appendix I. Definitions of the demographic and socioeconomic terms are in appendix II.

VISION EXAMINATION

The vision examination for youths was developed with the advice of Dr. J. Theodore Schwartz, Ophthalmologist, at that time with the National Institute of Neurological Diseases and Stroke, and Dr. Herbert A. Urweider, Ophthalmologist, George Washington University School of Medicine. It included tests to detect and classify color vision deficiencies, both monocular and binocular tests to determine the level of distance and near central visual acuity, tests of lateral phoria at distance and near, trial lens tests for myopia given at distance to those scoring less than 20/20 (Snellen) at distance, and lensometer measurements of the correction in the refractive lenses worn by the examinee. Color vision tests were given with the examinee's usual correction—glasses or other refractive lenses. The other vision tests were done without correction; for those who had their glasses or other refractive lenses with them, the distance tests were also done with their usual correction. These tests were administered by the examining dentist because of space limitations in the mobile examination centers and because this member of the examining team had the requisite time available.

The vision test battery for youths was expanded from that used for children because of the reportedly large increase in the incidence of myopia at or around puberty. Distance vision tests with the examinee's usual corrective lenses, not included in the children's examination, were also done since the proportion of youths with glasses or contact lenses was sufficiently large to provide reliable national estimates for these data.

In addition to the vision tests, each youth was given an eye examination by the survey staff pediatrician. This included a careful, general inspection for evidence of abnormal conditions of the lids, conjunctivae, sclerae, pupils, and irides; a cover test to detect the presence of any

tropia; an inspection of the conjugate gaze; and determination of the focusing or dominant eye.

This report contains the findings with respect to monocular and binocular central visual acuity at distance and near, both without and with usual correction.

Testing Instruments

The same type of instrument, the Master Ortho-Rater, was used in testing the visual acuity of youth as that employed in the children's study because of the need for data comparable with the latter as well as for consistent uniformity in testing within available space and time limitations. For the few youths (only 3) who were unable to read letters in the alloted time, the Landolt ring charts specially designed for this purpose for the children's study were used.[6] Because so few youths were illiterate, these findings were used as the basis for estimating what their acuity level would have been on the slightly more difficult letter targets and are not shown separately.

The Master Ortho-Rater device consists of a viewing box and two illuminated slide holders with two sets of test slides mounted inside the metal case. Slides used to test distance vision are mounted on an illuminated drum located at the right side of the instrument; those used to test near vision, on an illuminated drum at the left. A spring switch holds each drum accurately at each possible position. Only the slide in focus is illuminated. Without changing the position of the head of the examinee, the viewing box is tipped up to a set position for distance viewing and down slightly into a set position for near. The instrument is also adjustable for differences in eye height (above the chinrest). Distance targets or slides are viewed at a distance of 26 feet simulated optically by means of convex lenses and near targets at 13 inches.

This instrument permits rapid testing under controlled conditions of lighting and target distance from the examinee. The effective illumination on the target and the contrast between target letters and background were maintained within optimum limits for such tests.[7]

Selected targets developed by Dr. Louise Sloan of the Wilmer Eye Institute at Johns Hopkins University for the Armed Forces[8] were used in the Master Ortho-Rater during the survey. These targets on the slides in the instrument consisted of lines of optotypes which were letters appropriately graded in size from one line to the next and arranged in decreasing size from the top to the bottom of the slide to test at 12 levels from ones corresponding to 20/12 to 20/400 (Snellen notation). These levels consisted of the equivalents of 20/12, 20/15, 20/17, 20/20, 20/25, 20/30, 20/40, 20/50, 20/70, 20/100, 20/200, and 20/400 at distance with the 12 corresponding equivalents at near. The 10 unserifed letters used were of nearly equal legibility and were arranged in random order—differing for each line, each eye, and for distance and near. As previously described, these letters met the recommendations of the Committee on Optics and Visual Physiology of the American Medical Association.[9,10] The letters followed the Snellen principle with their height as well as their width five times the width of the lines in the letters. The targets consisted of 10 letters per line arranged in groups of 5 each for testing from 20/12 to 20/200 and 3 letters at 20/400 (and their equivalents at near), as shown in appendix III.

Testing Methods

Testing methods were identical in the children and youth studies. The testing order for youth of right eye, left eye, and binocular vision was maintained throughout the cycle. The sequence of near and distance tests was alternated for successive examinees, a degree of randomization employed to minimize any consistent bias for either test series due to fatigue, practice, or learning the target letters. Acuity tests were given first without glasses or other refractive lenses. Then for those youth who had their glasses or lenses with them, the test battery was repeated with their own refractive lenses.

Each youth was asked to read the line corresponding to an acuity level of 20/30 (or the equivalent at near). If he was unable to do this with no more than the allowable number of errors to "pass," he was presented the line corresponding to an acuity comparable to 20/50. If the youth again failed, he was started at the 20/400 line.

The youth read the lines of progressively smaller letters until he failed or completed the test.

The few slow readers who were tested on the Landolt ring charts in order to obtain some estimate of their acuity level were started on the line with the largest rings (20/200 at distance or equivalent at near). The youth was asked to point in the direction of the "bite" in the ring. The examiner continued this procedure for the first ring in a few consecutive lines until he was sure the youth understood the test and was able to continue unassisted until he completed the test or failed.

To "pass" or to be able to read at a particular level, no errors were allowed if the line contained three letters, one in lines of five symbols, and three in lines of 10 letters. The visual acuity level or "score" for an examinee was that which corresponded to the smallest letters or symbols that the youth was able to read with no more than the allowable number of errors.

Quality Control

As in the children's cycle, vision tests for youth were administered by the survey staff examining dentist because that member of the survey team had the time available. The effect of this was to have these tests done by a professional person who, once the necessary special training had been given, was very adept at administering the tests. Each of the five dentists employed during the cycle was given training and practice in vision testing techniques to insure the consistency of test results. Further practice was obtained during the "dry runs" preceding the start of the regular examinations at each of the 40 areas in which the mobile health examination centers were located.

A feasibility study of the new battery of vision tests was done at the National Training School for Boys in Washington, D.C., under Dr. Urweider's direction prior to the start of the third cycle. Later in Chicago, midway in this cycle, Dr. Urweider directed a methodological study to validate results from the trial lens test for myopia and the lateral phoria tests against a thorough clinical examination.

Visual acuity test results appeared to remain consistent for the various regular examiners throughout the cycle. The proportion of youth rated as having normal or better vision showed essentially no differences which might be attributable to the testers when the age and sex differences among examinees at the various locations were removed (appendix I).

Testing equipment and illumination were checked periodically throughout the cycle to be sure that the former were in good working order and that both met the required standards.

FINDINGS

Binocular Acuity, Uncorrected

Distance.—More than two-thirds (70.3 percent), or 15.9 million youths 12-17 years of age in the noninstitutional population of the United States have at least "normal" or better than "normal" unaided binocular distance vision, as estimated from the Health Examination Survey findings of 1966-1970. Sixty-one percent were able to read at levels of 20/17 or better and 75 percent tested 20/25 or better (tables 1, 2, and figure 1).

The median uncorrected binocular acuity for youth was 20/15.7. Thus half were able to read at 20 feet (simulated) letters of the same size that persons with so-called "normal" visual acuity (20/20) would need to be within 15.7 feet of the target to read. This median acuity exceeds the median of 20/17.4 for noninstitutionalized U.S. children 6-11 years of age in 1963-65 but is just slightly below the median of 20/15 for civilian noninstitutionalized young U.S. adults 18-24 years of age in 1960-62.[11] The differences between this midpoint value for either the youth or the young adult group and the children are statistically significant, exceeding the 95-percent confidence limit for these national estimates.

Proportionately fewer youth than children could read or pass at the 20/20 level or better without corrective lenses—70 percent compared with 75 percent for children, a difference that is statistically significant. Among young adults 18-24 years of age in the earlier study (1960-62) the proportion reading at this level was 75 percent. While this proportion is also significantly greater than among the youth, the difference

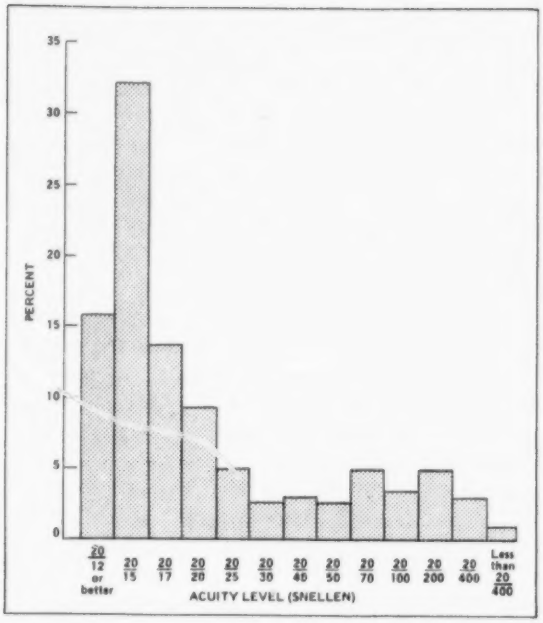

Figure 1. Percent of youths 12-17 years reaching specified acuity levels for binocular distance vision: United States, 1966-70

here may be due, at least in part if not entirely, to differences in the test targets instead of to any real difference in the proportion with better visual acuity between the youth and young adults. A more precise vision test was used in the examination of the youth (as well as of the children) than that administered in the adult study.

Mildly defective vision of 20/25 to 20/50 was found substantially less frequently among youth than children (13 percent for 12-17 years compared with 19 percent for 6-11 years) while the proportion of young adults testing in this range (16 percent for 18-24 years) did not differ significantly from either the younger or older group. The proportion of persons in the United States with moderately to severly defective acuity (20/70 or poorer) was substantially greater among the youth (17 percent) than either the children (6 percent) or the young adults (9 percent), as indicated in figure 2.

Almost 4 percent of the youth from the present study were unable to read at the 20/200 level unaided, a rate that is significantly greater than that found among children (0.8 percent), as would be expected. The prevalence rate for this degree of visual defect among youth is also slightly, but not significantly, greater than the rate of 1.7 percent found among the young U.S. adults. At these lower levels of 20/100 and 20/200 particularly, the test target used in the adult study was much less precise than those used for youth and children.

On the basis of these findings it can be said with a fair degree of certainty that the actual proportion of youth with such severely defective binocular distance vision (below 20/200) is within the range of 3 to 5 percent. This group will include the legally blind as well as those whose acuity could be improved with lenses.

A trend by age was found within only one of the 12 binocular distance acuity levels for adolescents. There is a consistent significant increase with age in the proportion of youth testing 20/12 or better from nearly 12 percent among those 12 years old to 20 percent among those aged 17 years.

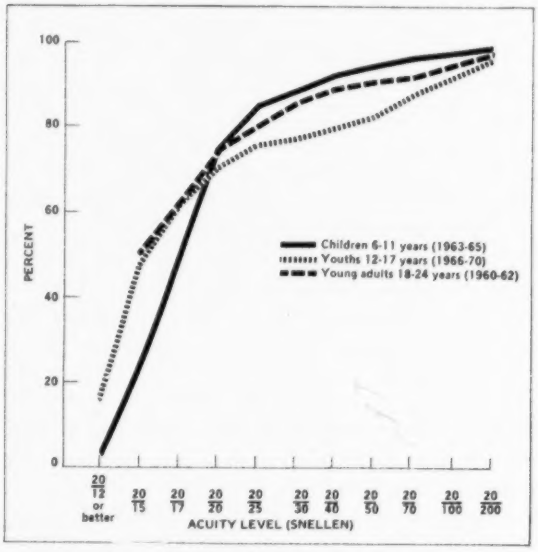

Figure 2. Cumulative distribution of acuity of children (6-11 years in 1963-65), youths (12-17 years in 1966-70), and young adults (18-24 in 1960-62) for uncorrected binocular distance vision: United States

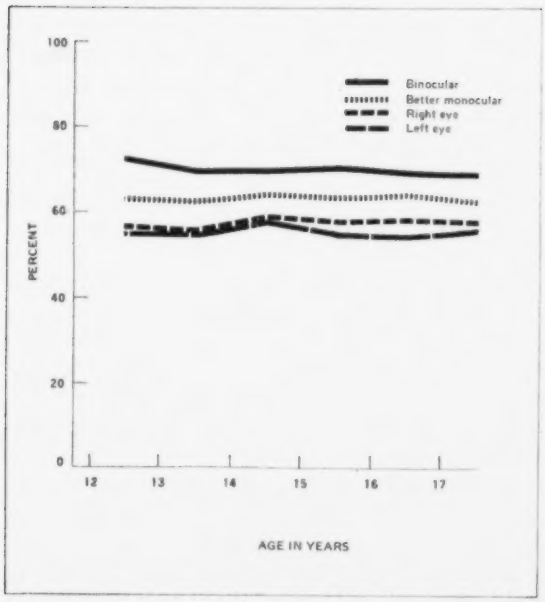

Figure 3. Percent of youths 12-17 years reaching acuity levels of 20/20 or better for uncorrected binocular and monocular distance vision, by age: United States, 1966-70.

The proportion of youth at each year of age with at least normal vision is remarkably consistent (figure 3). Only a narrow range separates the 12-year-olds (72 percent) from the 17-year-olds (69 percent). Even as youth from the mildly defective acuity levels are added to the normal group, the range does not widen greatly and in fact remains at 6 percent as the percents testing 20/30, 20/40, and 20/50 are added. The prevalence of mildly defective acuity of 20/25-20/50 is slightly greater among the younger adolescents 12 and 13 years of age (14 percent) than among those 14 years of age and over (11 to 12 percent).

Moderate to severely defective acuity of 20/70 or less is somewhat less prevalent among younger than older youth, ranging from nearly 14 percent at age 12 years to 20 percent at 16 years, with insignificant dips at ages 15 and 17 years (figure 4). A similar age-related pattern is also evident among those at the lower extreme of the acuity range—20/200 or less.

Binocular distance acuity was found to be substantially better for boys than girls, the differences being even greater among the youth than in the previous study among children but slightly less than among young adults. Seventy-four percent of the boys 12-17 years of age had acuity of 20/20 or better, while only 66 percent of the girls of this age reached that level, the difference being statistically significant at the 1-percent probability level. At the lower acuity levels (20/30 and poorer) the differences between boys and girls are present but are significant only at the 5-percent level (exceed the 95-percent confidence limits as shown in table A).

No trend by age is present among either boys or girls with at least normal unaided vision. Among boys, the proportion with acuity of 20/20 or better ranges from a low of 71 percent at age 16 years to 76 percent among the youngest groups 12 and 13 years of age, but it increases to 74 percent among the 17-year-olds. The proportion of boys with at least "near normal" acuity (20/25 or better) shows a downward trend by age from 81 percent at 12 years to 75 percent at 16 years but jumps back to 77 percent among those 17 years old. The rate for more severely defective

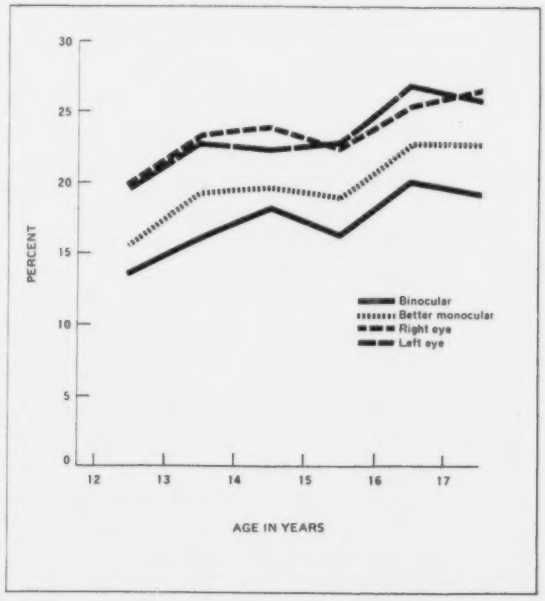

Figure 4. Percent of youths 12-17 years reaching acuity levels no better than 20/70 for uncorrected binocular and monocular distance vision, by age: United States, 1966-70.

Table A. Percent of boys and girls 12-17 years of age with at least normal, mildly defective, or moderately to severely defective binocular distance and near acuity without correction: United States, 1966-70

Sex	At least normal acuity (visual angle of 1.00 or better)		Mildly defective acuity (visual angle of 1.01-2.50)		Moderately to severely defective acuity (visual angle of 2.51 or poorer)	
	Distance (20/20+)	Near (13/13+)	Distance (20/25-20/50)	Near (13/16.25-13/32.5)	Distance (≤20/70)	Near (≤13/45.5)
Both sexes:						
Percent	70.3	83.7	12.6	11.4	17.1	4.9
Standard error	1.19	0.57	0.52	0.46	0.94	0.32
Boys:						
Percent	73.9	86.2	11.1	9.7	15.0	4.1
Standard error	0.98	0.67	0.70	0.58	0.80	0.42
Girls:						
Percent	66.3	81.5	14.3	12.8	19.4	5.7
Standard error	1.74	0.76	0.66	0.62	1.40	0.44

visual acuity of 20/70 or less is lower among the younger boys (12 percent at ages 12 and 13 years) than the older (16 percent at ages 15 and 17 years, 18 percent at 16 years).

Comparable percentages among the girls are somewhat more variable across the age range than those indicated for boys. The highest proportion of girls with at least normal acuity was found among those 12 and 15 years old (70 percent), while among the 13- and 17-year-olds the percentages were lowest (figure 5). The age pattern for the prevalence of poorer acuities (20/70 or worse) among girls was even less distinct.

Near.—The uncorrected binocular visual acuity of adolescents 12-17 years of age in the United States is significantly better at near than at distance (figures 1 and 6). More than 83 percent of the youths were able to read the test target letters of a size which subtended a visual angle of 1.00 minute at 13 inches from the eye (13/13 in Snellen notation) compared with the 70 percent reading at least at the approximately

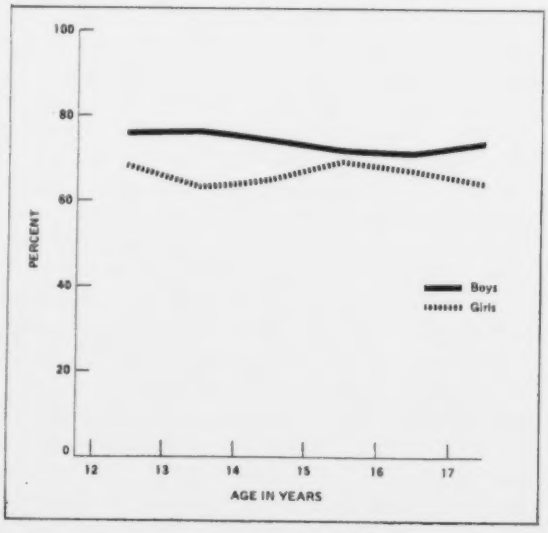

Figure 5. Percent of youths 12-17 years reaching acuity levels of 20/20 or better for uncorrected binocular distance vision, by age and sex: United States, 1966-70.

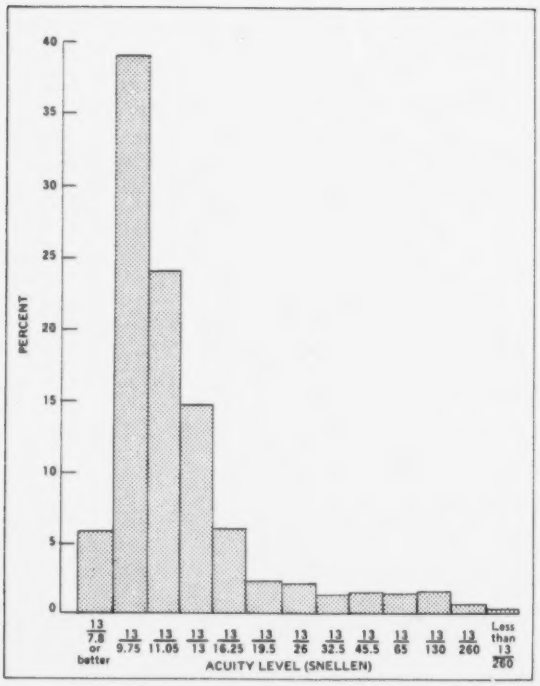

Figure 6. Percent of youths 12-17 years reaching specified acuity levels for binocular near vision: United States, 1966-70

equivalent level at distance—letters of a size which subtended a visual angle of 1.00 at 20 feet (20/20 Snellen). Over 89 percent tested at least at the visual angle of 1.25 at near (13/16.25 Snellen) compared with the 75 percent reaching the approximately equivalent or better level at distance (20/25 Snellen). The difference in these percents is significant at the 1-percent probability level or exceeds the 99-percent confidence limit for these national estimates (tables 2 and 3).

For convenience in comparing visual acuity at distance and at near, acuity levels are expressed here where expedient in terms of the visual angle in minutes of arc subtended by the letters of specified size on the target at the set distances for the respective targets (20 feet at distance and 13 inches at near). The Snellen ratio or notation is the reciprocal of the visual angle. A chart containing all of the test target equivalents may be found in appendix III.

The prevalence of mildly defective visual acuity among youth at near and distance is similar—11 percent at near compared with 13 percent at distance test within the range of 1.01-2.50 minutes (13/16.25-13/32.5 at near and 20/25-20/50 at distance, Snellen).

Among those with moderately or more severely defective acuity levels of 2.51 minutes or more, only 5 percent of youths tested in this range at near (13/45.5 or less) compared with 17 percent at distance (20/70 or less), a difference that is statistically significant at the 1-percent probability level.

The findings among the youth with respect to the proportion having at least normal (84 percent) or moderately to severely defective near vision (5 percent) are similar to those for young adults 18-24 years of age in the 1960-62 study, where the respective percentages were 83 and 4 percent. In contrast, relatively fewer children 6-11 years of age tested either at the 13/13 level or better (73 percent) or at the lower extreme of 13/45.5 or less (2 percent).

Among adolescents there was no consistent trend by age in the proportion testing at any of the near binocular acuity levels, similar to the findings for children. The proportions with 13/13 or better vision range from a high of over 84 percent for those 12 and 13 years old to a low of 83 percent at age 14, an insignificant difference (figure 7).

As with distance acuity, boys 12-17 years of age were found to have substantially better near acuity than girls. The differences are statistically significant at the 1-percent level for the proportions with acuity of 13/13 or better (86 percent compared with 80 percent) and mildly defective acuity of 13/16.25 through 13/32.5. At the lower extreme of the acuity range, 13/45.5 or poorer, the difference between the proportion of boys and girls (4 percent compared with nearly 6 percent) is significant at the 5-percent level.

Monocular Acuity, Uncorrected

Monocular visual acuity of youth is in general substantially poorer than their binocular acuity. Less than two-thirds (63 percent) of the U.S. youth, or an estimated 14.4 million, had at least normal distance acuity in their better eye without correction. Roughly 71 percent could read at least at the 20/25 level, while over 19 percent had acuities of 20/70 or less in the better eye.

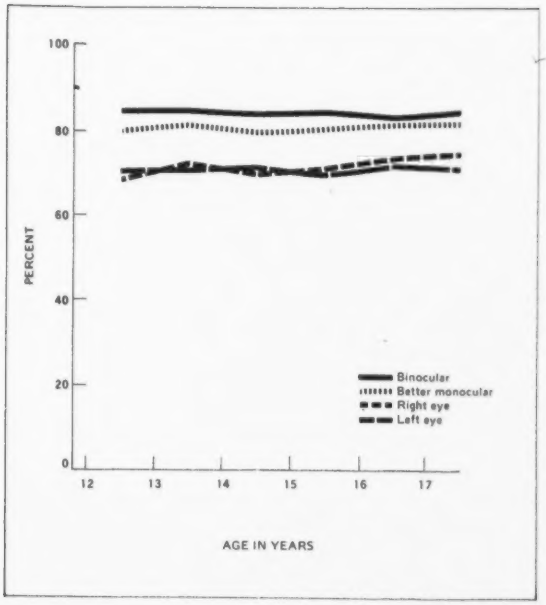

Figure 7. Percent of youths 12-17 years reaching acuity levels of 13/13 or better for uncorrected binocular and monocular near vision, by age: United States, 1966-70.

The prevalence rate for better monocular acuity of at least 20/20 was nearly identical among youth (63 percent) and children (62 percent) but significantly higher among young U.S. adults (68 percent).[12] Relatively substantially fewer of the U.S. children and young adults than the youth were found to have moderate to severely defective uncorrected distance acuity in the better eye (8 percent of children and 10 percent of young adults compared with 20 percent of youth). Again the unexpected deviant findings among young adults may be attributable at least in part to test target differences. It is interesting to note that there was a greater difference found among children between their binocular and better monocular acuity (13 percent fewer tested at least 20/20 with their better eye) than among either youth or young adults, where the corresponding difference was only 7 percent.

No consistent age trend in the proportion of youths within any single better monocular acuity level at distance is present other than for those testing 20/12 or better, similar to the findings with respect to binocular distance acuity for youth. These findings are also consistent with those for U.S. children in the 1963-65 study. Among youth the proportion testing at the 20/12 level increases from 4 percent at age 12 through 14 years to 7 percent at ages 16 and 17 (table 4). This difference is significant at the 5-percent level.

Boys, in general, have substantially better monocular, as well as binocular distance vision than do girls. Highly significant differences are evident in the prevalence rates for better monocular acuity of at least 20/15 among boys and girls 12-17 years of age, and these differences are still present when the adolescents are grouped into the broader acuity classes of at least "normal" (20/20 or better), mildly defective (20/25-20/50), and moderately to severely defective (20/70 or poorer). The proportion of boys testing 20/20 or better is significantly greater than that for girls, while a much larger proportion of girls are classed here as having mildly or moderately to severely defective visual acuity in their better eye (tables 4 and B). These findings are generally consistent with those for U.S. children in 1963-65 and young adults in 1960-62 from the previous studies.[6,12]

The acuity levels in the right and left eye tended to be similar for the majority of youth, as was found among children and young adults, and where differences did occur, no consistently significant pattern of eye dominance was evident. Among youth the proportion with at least "normal" acuity in the right eye was slightly better at all ages (figure 3). This trend is negligible but reversed for those with mildly defective monocular vision and is inconsistent at the poorer acuity levels (table 5 and figure 4). Among children (except at age 11 years) and young adults the proportion testing at least normal with their left eye was just slightly greater than for the right. Among all three age groups the monocular acuity for the better eye was significantly greater than for either eye alone.

Findings with respect to near monocular vision are similar to those for distance among youth. The proportion of youth 12-17 years of age with at least normal near vision in the better eye is significantly less than for binocular near vision across the age range in the study (figure

Table B. Percent of boys and girls 12-17 years of age with at least normal, mildly defective, or moderately to severely defective better monocular distance and near acuity without correction: United States, 1966-70

Sex	At least normal acuity (visual angle of 1.00 or better)		Mildly defective acuity (visual angle of 1.01-2.50)		Moderately to severely defective acuity (visual angle of 2.51 or poorer)	
	Distance (20/20+)	Near (13/13+)	Distance (20/25-20/50)	Near (13/16.25-13/32.5)	Distance (≤ 20/70)	Near (≤ 13/45.5)
Both sexes:						
Percent	63.6	80.2	16.8	14.5	19.6	5.3
Standard error	1.21	0.59	0.47	0.49	0.98	0.34
Boys:						
Percent	67.9	82.3	15.2	13.3	16.9	4.4
Standard error	1.05	0.79	0.69	0.65	0.78	0.47
Girls:						
Percent	59.1	77.7	18.4	15.9	22.4	6.4
Standard error	1.69	0.83	0.62	0.77	1.46	0.46

7 and tables 6 and 7); however, the differential is less than existed for distance vision (figure 3). Boys at near, as well as at distance, tended to have better monocular acuity than girls (table B).

Corrected Acuity

More than 34 percent, or an estimated 7.7 million, of the adolescents in the United States, owned either glasses or contact lenses, as estimated from medical history reports of parents for examinees in the Health Examination Survey of 1966-70. Information on the visual acuity of these youth with their usual corrective or refractive lenses is limited here to the examinees who brought their glasses or contact lenses with them to the examination—85 percent of the group who owned them.

With Own Lenses.—Among this group—28 percent of the youth—who were tested with and without their usual corrective lenses, less than 23 percent had unaided binocular distance acuity of at least 20/20, 22 percent had mildly defective acuity of 20/25-20/50, while 55 percent had moderately to severely defective acuity of 20/70 or less uncorrected.

More than 87 percent of the youths had binocular distance acuity of at least 20/20 with their usual corrective lenses, and over 94 percent could read at the 20/25 level or better (table 8). Less than 1 percent had moderately to severely defective binocular acuity of 20/70 or less with their glasses or contact lenses, while about 12 percent tested at 20/25-20/50. The median binocular acuity for this group with their usual lenses was 20/14.4.

A consistent age pattern is evident here in the prevalence rate for at least normal acuity. The proportion increases from 79 percent among the 12-year-olds to 94 percent among the 17-year-olds.

The proportion with acuity corrected to at least normal (20/20 or better) was slightly, but not significantly, larger among girls than boys

who wore glasses. At the other extreme of the scale, those with corrected acuity no better than 20/20, the proportion of girls was a negligible amount greater than that for boys.

Tests of near visual acuity with usual corrective lenses were not done in this examination among youth.

"With Usual Correction."—To determine the usual functional level of visual acuity in the youth population, test results with their usual corrective lenses have been combined with those for the youths tested only without glasses or contact lenses. The percent distribution of binocular distance acuity among all the youths on this basis, for convenience termed "with usual correction," (which needs to be understood as meaning here with usual correction, if any available) is contained in tables 9 and C.

The distribution of acuity "with usual correction" in the entire youth population is similar to that found among the 28 percent tested with their own glasses or contact lenses, indicating that the majority of those with substantially defective acuity have glasses or contact lenses that improve their vision to some extent. The proportion having at least normal binocular acuity was just slightly greater among the total group (88.2 percent compared with 87.6 percent for those with glasses or contact lenses), while the proportion with moderate to severely defective acuity (20/70 or less) was also greater (2.1 percent compared with 0.8 percent).

A distinct consistent improvement in acuity "with usual correction" with age is evident. This is similar to that found for those tested with their own corrective lenses but in distinct contrast to the absence of such a trend in the distribution of uncorrected acuity. The proportion testing at least 20/20 ("with usual correction") increases significantly from 85 percent at age 12 years to 93 percent at age 17 years, while the proportion with mildly defective acuity decreases steadily from 13 percent among the youngest age group (12 years) to 6 percent among the 17-year-olds. The rate for those with moderately to severely defective acuity shows a less consistent age pattern but is greater among the youth of 12-14 years (2.4-2.9 percent) than among those over 14 years of age (1.2 to 1.5 percent).

Even on the basis of results "with usual correction" the visual acuity of boys was better than that for girls of this age, though the differences are less substantial than those for the uncorrected acuities. Nearly 90 percent of boys

Table C. Percent of boys and girls 12-17 years of age with at least normal, mildly defective, or moderately to severely defective binocular distance acuity "with usual correction": United States, 1966-70

Sex	At least normal acuity (20/20+)	Mildly defective acuity (20/25-20/50)	Moderately to severely defective acuity (≤20/70)
Both sexes:			
Percent	88.2	9.7	2.1
Standard error	0.61	0.61	0.21
Boys:			
Percent	89.6	8.7	1.7
Standard error	0.69	0.73	0.28
Girls:			
Percent	87.1	10.5	2.4
Standard error	0.66	0.63	0.30

had at least normal acuity "with usual correction" compared with 87 percent of girls, a difference that is statistically significant. In the mildly defective range the respective proportions were 8.7 and 10.5 percent, while for the more severely defective they were 1.6 and 2.3 percent.

These findings among youth with respect to their binocular distance acuity "with usual correction" are remarkably similar to those for the young U.S. adults 18-24 years of age in the 1960-62 study. As indicated above, among the youth 12-17 years of age the proportion testing at least 20/20 was 88.2 percent compared with 87.7 for young adults. The comparable percents among males were identical (89.6), while there was a slightly greater difference at this level between girls and young women (87.1 percent compared with 86.0 percent). Relatively fewer young adults (0.3 percent) than youth (2.1 percent) tested 20/70 or less; however, test results from the two studies are probably not strictly comparable because of target differences, as indicated previously.

Relationship - Acuity Measures

The degree of the association among the uncorrected acuity levels for youth was highest between their binocular and better monocular vision at distance and near. At distance the correlation was +0.90 and at near +0.88 (table D). For both boys and girls the extent of agreement was essentially the same but slightly higher for girls. For the majority of youth (over 80 percent) their level of binocular acuity exceeds their better monocular acuity consistently by approximately one level.

Correlation between acuity levels for the right and left eye among youth was also of a high order. However, the association was much stronger at distance (+0.81) than at near (+0.60). Here again the findings were similar for boys and girls but the relationship was somewhat stronger among girls.

Acuity of youth at distance and near were also strongly related, and the magnitude of the association on all four measures was similar but lower than those cited above except for near monocular acuity. The correlations ranged from +0.65 for the right eye to +0.67 for both binocular and better monocular scores.

There is a marked similarity in the extent of agreement among acuity scores for youth and children. The correlation between binocular and better monocular levels for children both at distance and near was +0.94, just slightly greater than those of +0.90 and +0.88 found for these acuity measures among youth. Correlation between the levels for the right and left eye at distance and near were +0.78 and +0.57, differing only minimally from the corresponding values of +0.81 and +0.60 for adolescents in the present study. Only in the relationships between distance and near vision on the four acuity measures do youth show a stronger relationship than children.

Table D. Correlation between visual acuity measures for youths 12-17 years, by sex: United States, 1966-70

Acuity measure	Both sexes	Boys	Girls
Uncorrected	Correlation coefficients		
Distance and near:			
Binocular	+0.67	+0.64	+0.70
Better monocular	+0.67	+0.66	+0.68
Right eye	+0.65	+0.65	+0.65
Left eye	+0.66	+0.67	+0.64
Binocular and better monocular:			
Distance	+0.90	+0.88	+0.91
Near	+0.88	+0.86	+0.90
Right and left eye:			
Distance	+0.81	+0.79	+0.82
Near	+0.60	+0.58	+0.62
Corrected and uncorrected			
Binocular	+0.17	---	---
Better monocular	+0.14	---	---
Right eye	+0.17	---	---
Left eye	+0.20	---	---

The correlation of these acuity levels among youth range from +0.65 to +0.67 compared with +0.55 to +0.64 for children.

The degree of association for youth between their uncorrected and the corresponding corrected levels for binocular and monocular visual acuity are similar and significantly different from zero but of a substantially lower order of magnitude than those among the various uncorrected acuity measures.

Race

This section is limited to consideration of differences among white and Negro adolescents with respect to their visual acuity. The number of youth of other races in the United States and hence the number in the probability sample on which this study is based is too small and heterogeneous to give reliable estimates for this segment of the population.

Uncorrected Acuity.—The unaided binocular distance acuity of Negro adolescents is generally better than that of white youths (table 10). Striking differences between the races are found when acuity levels of at least normal and moderately to severely defective are considered. More than 77 percent of Negro youths had uncorrected binocular distance acuity of 20/20 or better compared with only 69 percent of white youths (figure 8), the difference being significant at the 1-percent level. This substantial racial difference in the proportion with better distance acuity was found among both boys (83 percent, Negro; 73 percent, white) and girls (73 percent, Negro; 65 percent, white), though for girls this difference is significant only at the 5-percent level (table E). At the other extreme of the acuity scale, proportionately twice as many white as Negro youth were found to have moderately to severely defective uncorrected distance acuity, 20/70 or less (18 percent compared with 9 percent). This pattern was similar among both boys and girls. Seven percent of Negro boys had this degree of visual defect compared with 16 percent of white boys, while among girls the corresponding rates were 11 percent (Negro girls) and 21 percent (white girls).

At each of the acuity levels of 20/25 or better the proportion of Negro youth exceeded that for white youth, though the individual differences were not large enough to be considered statistically significant. Proportionately more white than Negro youth were found consistently at each of the poorer acuity levels of 20/70 and less. Here the differences at all but the lowest acuity were statistically significant. The median acuity for white U.S. youth from this study was 20/15.7 compared with 20/14.7 for U.S. Negro youth.

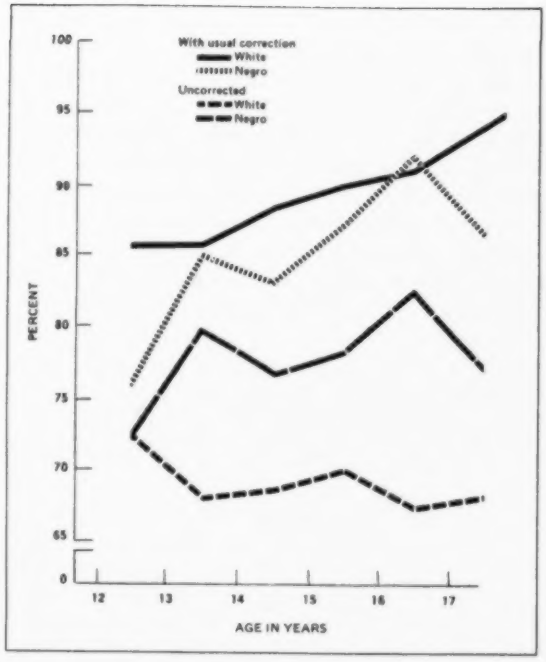

Figure 8. Percent of youths 12-17 years with normal or better binocular distance acuity tested with usual correction and with no correction, by race: United States, 1966-70

The pattern of racial differences in the unaided monocular visual acuity of youth was similar to that described above for their binocular vision, as indicated in table 10.

At near, the proportion with at least normal acuity was nearly identical among both white and Negro youth; however, the proportion with moderate to severely defective acuity was substantially greater among the white group.

These racial differences in uncorrected binocular distance acuity among youth are similar but somewhat more pronounced than those found

among U.S. children 6-11 years of age in the 1963-65 study and young U.S. adults 18-24 years of age in the 1960-62 study. In the survey among U.S. children no consistent racial differences in uncorrected acuity were found. Negro children under 10 years were more likely than whites to have at least normal distance acuity, though the difference in rates was too small to be significant. By ages 10 and 11 the pattern was reversed and consistent with that found among youth from 13 years on and among young adults (figure 9).

Corrected Acuity.— The pattern of racial differences in visual acuity for youth with their own corrective lenses was in sharp contrast to that for their unaided vision. While Negro adolescents generally had better unaided acuity than their white counterparts, a consistently larger proportion of white than Negro youth had superior vision with their own glasses or contact lenses. The racial differences in the prevalence rates for at least normal acuity were large enough to be considered statistically significant

Table E. Percent of white and Negro boys and girls 12-17 years of age with at least normal, mildly defective, or moderately to severely defective binocular distance acuity without correction and "with usual correction": United States, 1966-70

Sex	20/20 or better		20/25-20/50		20/70 or poorer	
	White	Negro	White	Negro	White	Negro
Without correction						
Both sexes:						
Percent	69.2	77.6	12.5	13.4	18.3	9.0
Standard error	1.35	1.54	0.73	1.69	1.07	1.27
Boys:						
Percent	72.9	82.5	11.1	10.6	16.0	6.9
Standard error	1.06	1.60	1.08	1.94	0.88	1.61
Girls:						
Percent	65.4	73.0	14.0	15.9	20.6	11.1
Standard error	2.03	2.27	1.05	1.83	1.58	1.95
"With usual correction"						
Both sexes:						
Percent	88.9	84.7	9.2	12.0	1.9	3.3
Standard	0.68	0.94	0.66	1.14	0.23	0.92
Boys:						
Percent	89.9	88.0	8.7	8.8	1.4	3.2
Standard error	0.78	1.55	0.79	1.50	0.28	1.32
Girls:						
Percent	88.1	81.3	9.7	15.2	2.2	3.5
Standard error	0.73	1.38	0.69	1.37	0.32	0.87

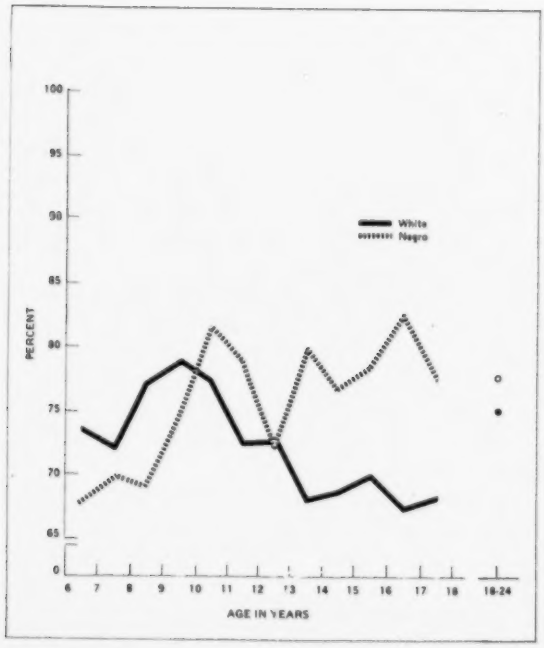

Figure 9. Percent of children (6-11 in 1963-65), youths (12-17 in 1966-70), and young adults (18-24 in 1960-62) with normal or better uncorrected binocular distance acuity, by race: United States.

for monocular but not binocular vision, nor did the rates for the two racial groups at the other extreme of the acuity scale--those with moderately to severely defective acuity--differ significantly.

With respect to their "usual correction" status substantially more white than Negro youths tested at the level of 20/20 or better, the difference in rates being statistically significant at the 5-percent level. This is similar to the findings for the smaller group who wore lenses.

These findings for unaided and corrected or "usual correction" status reflect differences in availability or use of adequate medical care between the two racial groups. Here it is readily apparent that while relatively fewer Negro than white youths need glasses, of those who do relatively fewer Negro than white youths have them.

Region

Uncorrected Acuity.—Striking regional differences were found in the unaided distance visual acuity of U.S. youth in 1966-70. More than 76 percent of the adolescents in the South had at least 20/20 unaided binocular distance acuity compared with 71 percent of those in the West, 69 percent in the Northeast, and less than 66 percent in the Midwest. This rate for the Southern youth is significantly greater than that in the Midwest (at the 1-percent level) and in the Northeast (at the 5-percent level). Moderately to severely defective acuity at distance was substantially less frequently found among the 12-17 year olds in the South (12 percent) than those in the other three regions (21 percent in the Midwest and 18 percent in the other two). Here again the differences between the Southern rate for this degree of visual defect and those in the Midwest and Northeast are large enough to be considered statistically significant.

The substantially better unaided acuity, in general, found among Southern youth is due at least in part to the fact that a disproportionate number of Negro youth live in that area, relatively over twice as many as in any one of the other regions.

Boys 12-17 years of age generally had better binocular distance acuity without correction than girls of that age in each of the four regions of the country. However, only in the Midwest and the South were the differences in the proportion with at least normal acuity large enough to be considered statistically significant (tables 11 and F).

Near vision without correction in contrast to the findings at distance tended to be somewhat more acute among youth in the West and less acute in the Northeast than elsewhere, though the differences among the regions in this respect are negligible.

Corrected Acuity.—Corrected acuity, whether considered for the entire youth population "with usual correction" or limited to the group tested with their own lenses, tended to be slightly but not significantly better among those in the West than youth in the other three regions.

The findings with respect to regional differences in unaided visual acuity of youth are slightly more pronounced, but not significantly so, than those found among U.S. children in 1963-65 and young U.S. adults 18-24 years of age in 1960-62.[13]

The state of refraction "with usual correction" shows even less of a regional pattern among youth than it did among young adults in the earlier study. Whether this reflects any change in the extent to which young people throughout the country have obtained and are wearing corrective lenses between the 1960-62 and 1966-70 periods or the fact that the regional boundaries differ in the two studies cannot be determined from the data available.

Population Size of Place of Residence

No consistent differences were found in visual acuity between urban and rural youths or among youths from cities of different sizes (table G). The proportion with at least normal unaided distance acuity (binocular) among rural youth was similar to that for their counterparts in cities of over 3 million population (71 percent), and the rates for both groups were slightly greater than among those from cities of 250,000 to 2.9 million population (66-68 percent). At near, the proportion testing 13/13 or better was somewhat lower (but not significantly so) among those from the largest urban communities than among those from elsewhere (81 percent compared with 83-90 percent).

The proportion of youth with moderately to severely defective acuity at distance ranged from 14 percent in urbanized areas under 250,000 to 21 percent in urbanized areas of 250,000-999,999 but also showed no consistent or significant pattern of relationship to population size of the area of residence.

These findings among U.S. youth differ slightly from those among U.S. children in the 1963-65 study, where a significantly larger proportion in rural areas than urban communities was found to have at least normal acuity.

Table F. Percent of boys and girls 12-17 years of age with at least normal or moderately to severely defective binocular distance acuity without correction by region: United States, 1966-70

Sex	20/20 or better				20/70 or poorer			
	Northeast	Midwest	South	West	Northeast	Midwest	South	West
Both sexes:								
Percent----------	69.2	65.6	76.4	70.7	17.5	20.8	11.9	17.5
Standard error---	2.67	1.91	1.79	4.03	2.56	1.45	0.97	2.87
Boys:								
Percent----------	72.1	70.0	80.0	74.5	16.7	18.2	10.6	13.8
Standard error---	2.63	1.96	1.67	2.70	2.46	1.37	0.82	2.14
Girls:								
Percent----------	66.3	60.9	72.6	66.7	18.3	23.6	13.3	21.2
Standard error---	3.21	2.82	2.10	5.96	2.85	2.57	1.42	4.40

Table G. Percent of youths 12-17 years with at least normal or moderately to severely defective binocular distance and near acuity without correction, by population size of place of residence: United States, 1966-70

Size of place of residence	At least normal acuity (visual angle of 1.00 or better)		Moderately to severely defective acuity (visual angle of 2.51 or poorer)	
	Distance (20/20+)	Near (13/13+)	Distance (20/70)	Near (13/45.5)
In urbanized areas				
Over 3 million:				
Percent	71.0	81.3	16.1	5.2
Standard error	1.69	1.39	1.13	0.55
1-2.9 million:				
Percent	68.5	83.8	18.0	5.0
Standard error	4.51	1.73	3.65	0.85
250,000 to 999,999:				
Percent	65.9	82.7	21.0	5.8
Standard error	3.52	3.02	3.57	1.59
Under 250,000:				
Percent	72.4	83.8	13.9	3.9
Standard error	4.40	2.43	3.80	0.99
Not in urbanized areas				
Over 25,000:				
Percent	72.2	84.8	15.4	2.1
Standard error	3.93	2.41	3.07	0.85
10,000 to 24,999:				
Percent	71.3	89.9	15.3	1.5
Standard error	3.28	3.52	3.32	0.96
2,500 to 9,999:				
Percent	70.6	85.0	19.2	5.7
Standard error	2.06	1.07	2.24	1.09
Rural:				
Percent	71.0	84.5	16.7	5.2
Standard error	1.96	0.72	1.05	0.47

Income

Unaided Acuity.--Some relationship may be seen between the unaided visual acuity of youth and the income level of their families (tables 12 and H). Those from families with annual income of less than $3,000 have significantly better acuity than those with incomes of $5,000 and over, with significantly more of the former group testing at least 20/20 and proportionately fewer testing at the 20/70 level or worse. A steady decrease in the proportion with at least normal acuity and an increase in the rate at the 20/70 or poorer levels was found as income increased up to $10,000. The pattern was similar but less consistent for near acuity.

The findings in this study of U.S. youth with respect to the relationship of family income and their unaided distance acuity are similar to those from the 1963-65 study among U.S. children. In

Table H. Percent of boys and girls 12-17 years of age with at least normal or moderately to severely defective binocular distance acuity without correction, by annual family income: United States, 1966-70

Sex	Annual family income					
	Under $3,000	$3,000-$4,999	$5,000-$6,999	$7,000-$9,999	$10,000-$14,999	$15,000 or more
20/20 or better						
Both sexes:						
Percent	76.6	72.5	69.4	69.4	66.1	68.5
Standard error	2.05	1.88	2.04	1.31	2.06	2.61
Boys:						
Percent	83.2	77.7	73.5	72.8	68.6	69.7
Standard error	2.41	1.78	2.24	1.35	2.26	3.06
Girls:						
Percent	70.6	67.3	65.5	65.5	63.4	67.1
Standard error	2.63	2.52	3.09	2.49	2.61	3.80
20/70 or poorer						
Both sexes:						
Percent	9.5	15.0	17.5	17.6	22.5	18.4
Standard error	1.21	1.72	1.59	1.00	1.67	2.04
Boys:						
Percent	6.3	11.8	14.7	16.2	20.3	17.6
Standard error	1.56	1.61	1.74	0.91	1.88	2.87
Girls:						
Percent	12.4	18.2	20.3	19.2	24.8	19.5
Standard error	2.05	2.30	2.31	1.75	2.22	2.92

the latter it was noted that defective visual acuity of 20/40 or less was found more frequently among children 6-11 years of age from families with moderate or higher incomes than for those in the lower income brackets. This pattern may also be seen among the youth with that degree of mild or more severely defective unaided distance acuity (table 12).

A stronger more consistent relationship is evident between family income and the refractive status of these youth. The proportion with at least normal binocular distance acuity "with usual correction" increased steadily from 85 percent at the lowest income level to 91 percent at the highest (figure 10), the differences between the extremes being statistically significant. The proportion testing 20/70 or less with their usual correction, if any, was correspondingly greater among those in the families with income under $7,000 than among those in the higher income brackets.

These findings reflect differentials by income in the availability or use of the required medical care since proportionately fewer in the lower income brackets needed glasses; but of those who did, proportionately fewer had the necessary refraction.

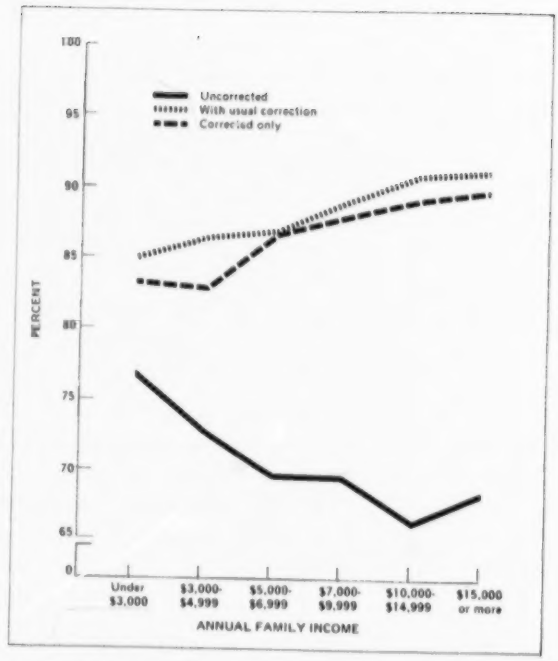

Figure 10. Percent of all youths 12-17 years with normal or better binocular distance acuity for uncorrected vision and for vision with usual correction, and the corresponding proportion among only those who wore corrective lenses, by annual family income: United States, 1966-70

SUMMARY

Visual acuity findings among youth 12-17 years of age in the noninstitutional population of the United States as determined in the Health Examination Survey of 1966-70 are presented and analyzed in this report. Included are findings with respect to binocular and monocular acuity, without and with correction. Racial, regional, urban-rural, and income differentials in visual acuity are also assessed.

In the Health Examination Survey program of 1966-70, a probability sample of 7,514 youth was selected to represent the 22.7 million noninstitutionalized youth of this age in the United States. Of these, the 6,768 examined, 90 percent of the sample, were closely representative of the youth population from which they were drawn with respect to age, sex, race, region, and other demographic and socioeconomic variables considered in the study.

Comparison is made throughout with the visual acuity findings among U.S. children 6-11 years of age from the 1963-65 Health Examination Survey and the young U.S. adults 18-24 years of age from the 1960-62 Health Examination Survey.

Major findings from the study among youth include:

1. More than two-thirds (70 percent), or 15.9 million of the youths 12-17 years of age in the noninstitutional population of the United States have at least "normal" or better than "normal" unaided binocular acuity at distance. This rate is significantly lower than the findings among children and young adults where 75 percent reached that level. The less precise target used in the earlier adult study probably accounts for at least part of the

inconsistency between acuity of youths and young adults.

2. Almost 4 percent of U.S. youths were unable to read at the 20/200 level unaided, significantly more than was found among U.S. children (0.8 percent) and slightly more than among young U.S. adults (1.7 percent). This group includes the legally blind as well as persons whose acuity could be improved with lenses.

3. Moderately to severely defective acuity of 20/70 or less is somewhat less prevalent among younger (12-14 years) than older youths (14-17 years), continuing the consistent trend with age found among children.

4. Boys 12-17 years of age were found to have substantially better binocular distance acuity than girls of that age, the differences being even more pronounced than among children and slightly greater than among young adults.

5. Closer agreement among youths was found between their binocular and better monocular acuity (correlation of +0.90 at distance, +0.88 at near) than between the acuity of their two eyes (+0.81 at distance, +0.60 at near), similar to the findings among children. For the majority of youths, their binocular acuity exceeds their better monocular acuity by approximately one test level. The latter, in turn, is slightly better than the level for either eye alone.

   Acuity of youths at distance and near were also highly correlated and the magnitude of the association was similar for binocular and monocular acuity at distance.

6. More than one-third (34 percent), or 7.7 million, of the youths were reported to wear glasses or contact lenses. Acuity test results with their own lenses were obtained for the 85 percent who brought these with them to the examination. Fifty-five percent of this group had moderately to severely defective acuity without their glasses or contact lenses compared with less than 1 percent when tested with their own lenses.

7. With their usual correction, if any, over 88 percent of U.S. youths had at least normal distance acuity compared with only 70 percent when uncorrected, while 2 percent had moderately to severely defective acuity of 20/70 or less compared with 4 percent when uncorrected. The proportion with moderately to severely defective acuity "with usual correction" was slightly greater among those 12-14 years old than youth 15 years and over.

8. Negro adolescents were found to have substantially better unaided visual acuity than white, a racial difference similar but more pronounced than that found among older children and young adults.

   In contrast, with correction white youths tended to have significantly better acuity than Negro youths. Hence while relatively fewer Negro than white youths needed glasses, of those who did relatively fewer Negro than white youths had adequate refraction.

9. The prevalence of at least normal unaided acuity among youths was greatest in the South, the rate being significantly higher than for those in the Northeast and Midwest. With correction no significant regional differences in acuity among youths were found.

   In contrast to the urban-rural differences in visual acuity found among children, no consistent pattern by size of area of residence was found among youths.

10. An association similar to that for children in the 1963-65 examination survey was found between unaided visual acuity of youths and the income level of their families. Youths from families with income of less than $3,000 per year had significantly better unaided acuity than those from families with incomes of $5,000 or more.

    A stronger more consistent but reversed relationship was evident between family income and the refraction status of youths. The proportion testing "with usual correction" at least normal increased steadily with income, while the proportion with moderately to severely defective acuity decreased. Thus while relatively fewer of the lower income groups needed glasses, of those who did, relatively fewer had adequate refraction.

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Table 1. Number of youths of 12-17 years reaching specified acuity levels for distance vision without correction, by age and sex: United States, 1966-70

Age and sex	Total	Acuity level - Snellen ratio				
		20/12 or better	20/15	20/17	20/20	20/25
	Number of youths in thousands					
Both sexes						
12-17 years	22,692	3,519	7,247	3,094	2,073	1,091
12 years	4,003	464	1,346	632	454	230
13 years	3,952	499	1,288	610	359	193
14 years	3,852	579	1,295	513	300	205
15 years	3,750	651	1,099	559	348	190
16 years	3,625	618	1,124	472	297	123
17 years	3,510	708	1,095	308	315	150
Boys						
12-17 years	11,489	2,258	3,826	1,446	973	497
12 years	2,032	310	725	282	230	108
13 years	2,006	300	721	326	177	87
14 years	1,951	328	710	258	153	84
15 years	1,900	440	527	240	160	92
16 years	1,836	406	595	194	114	66
17 years	1,764	474	548	146	139	60
Girls						
12-17 years	11,203	1,261	3,421	1,648	1,100	594
12 years	1,970	154	622	351	224	123
13 years	1,946	199	565	283	183	107
14 years	1,901	251	585	255	146	120
15 years	1,850	210	573	319	187	98
16 years	1,789	213	528	278	184	57
17 years	1,747	234	548	162	176	89

Table 1. Number of youths of 12-17 years reaching specified acuity levels for distance vision without correction, by age and sex: United States, 1966-70—Con.

Acuity level - Snellen ratio							
20/30	20/40	20/50	20/70	21/100	20/200	20/400	Less than 20/400
Number of youths in thousands							
570	644	566	1,121	772	1,114	671	210
127	107	98	196	125	141	67	16
90	136	142	205	150	164	87	29
86	114	61	165	135	224	128	47
96	103	93	184	112	200	81	34
81	94	86	171	142	189	176	52
90	90	86	200	108	196	132	32
306	239	230	467	378	490	278	101
62	24	41	95	61	61	26	7
43	57	46	81	67	64	28	9
63	57	15	55	43	94	54	37
44	37	52	76	75	107	34	16
42	41	42	76	88	82	70	20
52	23	34	84	44	82	66	12
264	405	336	654	394	624	393	109
65	82	57	100	64	79	40	9
47	80	96	124	83	100	59	20
23	58	46	111	92	130	74	10
52	66	41	108	37	93	47	19
39	53	44	95	54	107	106	31
38	66	52	116	64	115	67	20

Table 2. Percent of youths of 12-17 years reaching or reaching and exceeding specified acuity levels for binocular distance vision without correction, by age and sex, with standard errors for totals: United States, 1966-70

Age and sex	Acuity level - Snellen ratio												
	20/12 or better	20/15	20/17	20/20	20/25	20/30	20/40	20/50	20/70	20/100	20/200	20/400	Less than 20/400
	Visual angles												
	0.60 or less	0.75	0.85	1.00	1.25	1.50	2.00	2.50	3.50	5.00	10.00	20.00	More than 20.00
Both sexes	Percent of youths												
12-17 years----	15.6	32.0	13.6	9.1	4.8	2.5	2.8	2.5	4.9	3.4	4.9	3.0	0.9
Standard error of total------	0.84	1.00	0.38	0.34	0.25	0.16	0.23	0.20	0.30	0.29	0.39	0.26	0.16
12 years----------	11.6	33.7	15.9	11.3	5.7	3.2	2.6	2.4	4.9	3.1	3.5	1.7	0.4
13 years----------	12.6	32.6	15.4	9.1	4.9	2.3	3.4	3.6	5.2	3.8	4.2	2.2	0.7
14 years----------	15.0	33.7	13.3	7.8	5.3	2.2	3.0	1.6	4.3	3.5	5.8	3.3	1.2
15 years----------	17.4	29.2	14.9	9.3	5.1	2.6	2.7	2.5	4.9	3.0	5.3	2.2	0.9
16 years----------	17.1	31.1	13.0	8.2	3.4	2.2	2.6	2.4	4.7	3.9	5.2	4.8	1.4
17 years----------	20.0	31.1	8.8	9.0	4.3	2.6	2.6	2.5	5.7	3.1	5.6	3.8	0.9
Boys													
12-17 years----	19.6	33.2	12.6	8.5	4.3	2.7	2.1	2.0	4.1	3.3	4.3	2.4	0.9
Standard error of total------	1.07	1.39	0.49	0.46	0.30	0.28	0.28	0.29	0.33	0.29	0.35	0.31	0.14
12 years----------	15.3	35.5	13.9	11.3	5.3	3.1	1.2	2.0	4.7	3.0	3.0	1.3	0.4
13 years----------	15.0	36.1	16.3	8.8	4.3	2.1	2.8	2.3	4.0	3.3	3.2	1.4	0.4
14 years----------	16.8	36.5	13.2	7.8	4.3	3.2	2.9	0.8	2.8	2.2	4.8	2.8	1.9
15 years----------	23.3	27.8	12.6	8.4	4.8	2.3	1.9	2.7	4.0	4.0	5.6	1.8	0.8
16 years----------	22.1	32.4	10.6	6.2	3.6	2.3	2.2	2.3	4.1	4.8	4.5	3.8	1.1
17 years----------	26.8	31.0	8.3	7.9	3.4	3.0	1.4	2.0	4.8	2.5	4.6	3.7	0.6
Girls													
12-17 years----	11.2	30.6	14.7	9.8	5.3	2.4	3.6	3.0	5.8	3.5	5.6	3.5	1.0
Standard error of total------	0.80	0.87	0.63	0.51	0.38	0.24	0.39	0.26	0.54	0.36	0.61	0.38	0.27
12 years----------	7.8	31.7	17.8	11.4	6.2	3.3	4.1	2.9	5.1	3.2	4.0	2.0	0.5
13 years----------	10.2	29.1	14.6	9.4	5.5	2.4	4.1	4.9	6.4	4.3	5.1	3.0	1.0
14 years----------	13.2	30.9	13.5	7.7	6.3	1.2	3.0	2.4	5.8	4.8	6.8	3.9	0.5
15 years----------	11.4	31.0	17.2	10.1	5.3	2.8	3.6	2.2	5.8	2.0	5.0	2.6	1.0
16 years----------	11.9	29.5	15.5	10.3	3.2	2.2	3.0	2.4	5.3	3.0	6.0	5.9	1.8
17 years----------	13.3	31.3	9.3	10.1	5.1	2.2	3.8	3.0	6.6	3.7	6.6	3.8	1.2
Both sexes	Cumulative percent												
12-17 years----	15.6	47.6	61.2	70.3	75.1	77.6	80.4	82.9	87.8	91.2	96.1	99.1	100.0
12 years----------	11.6	45.3	61.2	72.5	78.2	81.4	84.0	86.4	91.3	94.4	97.9	99.6	100.0
13 years----------	12.6	45.2	60.6	69.7	74.6	76.9	80.3	83.9	89.1	92.9	97.1	99.3	100.0
14 years----------	15.0	48.7	62.0	69.8	75.1	77.3	80.3	81.9	86.2	89.7	95.5	98.8	100.0
15 years----------	17.4	46.6	61.5	70.8	75.9	78.5	81.2	83.7	88.6	91.6	96.9	99.1	100.0
16 years----------	17.1	48.2	61.2	69.4	72.8	75.0	77.6	80.0	84.7	88.6	93.8	98.6	100.0
17 years----------	20.0	51.1	59.9	68.9	73.2	75.8	78.4	80.9	86.6	89.7	95.3	99.1	100.0
Boys													
12-17 years----	19.6	52.8	65.4	73.9	78.2	80.9	83.0	85.0	89.1	92.4	96.7	99.1	100.0
12 years----------	15.3	50.8	64.7	76.0	81.3	84.4	85.6	87.6	92.3	95.3	98.3	99.6	100.0
13 years----------	15.0	51.1	67.4	76.2	80.5	82.6	85.4	87.7	91.7	95.0	98.2	99.6	100.0
14 years----------	16.8	53.3	66.5	74.3	78.6	81.8	84.7	85.5	88.3	90.5	95.3	98.1	100.0
15 years----------	23.3	51.1	63.7	72.1	76.9	79.2	81.1	83.8	87.8	91.8	97.4	99.2	100.0
16 years----------	22.1	54.5	65.1	71.3	74.9	77.2	79.4	81.7	85.8	90.6	95.1	98.9	100.0
17 years----------	26.8	57.8	66.1	74.0	77.4	80.4	81.8	83.8	88.6	91.1	95.7	99.4	100.0
Girls													
12-17 years----	11.2	41.8	56.5	66.3	71.6	74.0	77.6	80.6	86.4	89.9	95.5	99.0	100.0
12 years----------	7.8	39.5	57.3	68.7	74.9	78.2	82.3	85.2	90.3	93.5	97.5	99.5	100.0
13 years----------	10.2	39.3	53.9	63.3	68.8	71.2	75.3	80.2	86.6	90.9	96.0	99.0	100.0
14 years----------	13.2	44.1	57.6	65.3	71.6	72.8	75.8	78.2	84.0	88.8	95.6	99.5	100.0
15 years----------	11.4	42.4	59.6	69.7	75.0	77.8	81.4	83.6	89.4	91.4	96.4	99.0	100.0
16 years----------	11.9	41.4	56.9	67.2	70.4	72.6	75.6	78.0	83.3	86.3	92.3	98.2	100.0
17 years----------	13.4	44.6	53.9	64.0	69.1	71.3	75.1	78.1	84.7	88.4	95.0	98.8	100.0

Table 3. Percent of youths of 12-17 years reaching or reaching and exceeding specified acuity levels for binocular near vision without correction, by age and sex, with standard errors for totals: United States, 1966-70

Age and sex	Acuity level - Snellen ratio												
	13/7.8 or better	13/9.75	13/11.05	13/13	13/16.25	13/19.5	13/26	13/32.5	13/45.5	13/65	13/130	13/260	Less than 13/260
	Visual angle												
	0.60 or less	0.75	0.85	1.00	1.25	1.50	2.00	2.50	3.50	5.00	10.00	20.00	More than 20.00
	Percent of youths												
Both sexes													
12-17 years	5.9	39.3	24.0	14.5	5.9	2.2	2.1	1.2	1.4	1.3	1.5	0.5	0.2
Standard error of total	0.38	0.69	0.72	0.39	0.32	0.16	0.16	0.17	0.11	0.14	0.16	0.14	0.05
12 years	4.4	38.6	23.8	17.4	6.9	2.7	1.8	1.0	1.0	0.9	1.0	0.2	0.2
13 years	4.3	36.5	27.1	16.4	6.1	2.5	1.2	1.0	1.6	1.6	1.2	0.3	0.1
14 years	4.7	41.5	22.3	14.6	5.7	1.4	3.1	1.0	1.4	1.6	1.9	0.6	0.2
15 years	7.0	38.9	23.0	15.0	6.5	2.3	2.2	0.9	1.4	1.1	1.3	0.2	0.2
16 years	7.8	40.0	23.1	12.3	4.8	1.8	3.0	1.6	1.3	1.7	1.5	0.8	0.3
17 years	7.6	41.0	24.8	11.0	5.2	2.4	1.2	1.4	1.4	0.8	2.0	1.0	0.2
Boys													
12-17 years	7.9	42.1	22.8	13.4	5.3	1.9	1.7	0.8	1.0	1.1	1.3	0.5	0.2
Standard error of total	0.62	0.94	0.90	0.64	0.49	0.25	0.18	0.14	0.10	0.18	0.23	0.13	0.06
12 years	6.6	41.0	23.8	15.8	5.4	2.5	1.7	0.4	1.0	1.0	0.3	0.3	0.2
13 years	4.5	39.9	28.0	15.3	6.1	1.5	0.8	0.4	1.2	1.3	0.8	0.1	0.1
14 years	6.5	44.4	20.5	12.9	5.7	1.5	2.7	0.3	0.3	1.6	2.6	0.6	0.4
15 years	9.0	41.8	19.4	15.4	5.8	2.7	2.2	0.3	1.1	0.6	1.2	0.3	0.2
16 years	10.0	41.9	21.8	11.5	4.8	2.1	1.8	1.3	1.3	1.6	0.6	1.0	0.3
17 years	11.3	43.7	22.7	8.9	4.0	1.3	1.1	2.0	1.1	0.4	2.4	0.9	0.2
Girls													
12-17 years	3.8	36.6	25.4	15.7	6.5	2.4	2.4	1.5	1.7	1.5	1.7	0.6	0.2
Standard error of total	0.38	1.07	0.80	0.59	0.45	0.22	0.31	0.24	0.20	0.19	0.20	0.22	0.08
12 years	2.1	36.2	23.8	19.0	8.5	2.9	1.8	1.6	1.1	0.8	1.6	0.3	0.3
13 years	4.1	32.8	26.1	17.6	6.1	3.5	1.6	1.6	2.0	2.0	1.9	0.6	0.1
14 years	2.8	38.7	24.3	16.2	5.6	1.4	3.5	1.7	2.5	1.6	1.2	0.5	-
15 years	4.9	35.9	26.7	14.7	7.2	1.9	2.1	1.5	1.7	1.6	1.4	0.2	0.2
16 years	5.6	38.1	24.5	13.0	4.8	1.5	4.2	1.9	1.4	1.7	2.4	0.6	0.3
17 years	3.7	38.3	26.7	12.9	6.5	3.5	1.4	0.9	1.8	1.3	1.6	1.2	0.2
	Cumulative percent												
Both sexes													
12-17 years	5.9	45.2	69.2	83.7	89.6	91.8	93.9	95.1	96.5	97.8	99.3	99.8	100.0
12 years	4.4	43.0	66.8	84.2	91.1	93.8	95.6	96.6	97.6	98.5	99.5	99.8	100.0
13 years	4.3	40.8	67.9	84.3	90.4	92.9	94.1	95.1	96.7	98.3	99.6	99.9	100.0
14 years	4.7	46.2	68.5	83.1	88.8	90.2	93.3	94.3	95.7	97.3	99.2	99.8	100.0
15 years	7.0	45.9	68.9	83.9	90.4	92.7	94.9	95.8	97.2	98.3	99.6	99.8	100.0
16 years	7.8	47.8	70.9	83.2	88.0	89.8	92.8	94.4	95.7	97.4	98.9	99.7	100.0
17 years	7.6	48.6	73.4	84.4	89.6	92.0	93.2	94.6	96.0	96.8	98.8	99.8	100.0
Boys													
12-17 years	7.9	50.0	72.8	86.2	91.5	93.4	95.1	95.9	96.9	98.0	99.3	99.8	100.0
12 years	6.6	47.6	71.4	87.2	92.6	95.1	96.8	97.2	98.2	99.2	99.5	99.8	100.0
13 years	4.5	44.4	72.4	87.7	93.8	95.3	96.1	96.5	97.7	99.0	99.8	99.9	100.0
14 years	6.5	50.9	71.4	84.3	90.0	91.5	94.2	94.5	94.8	96.4	99.0	99.6	100.0
15 years	9.0	50.8	70.2	85.6	91.4	94.1	96.3	96.6	97.7	98.3	99.5	99.8	100.0
16 years	10.0	51.9	73.7	85.2	90.0	92.1	93.9	95.2	96.5	98.1	98.7	99.7	100.0
17 years	11.3	55.0	77.7	86.6	90.6	91.9	93.0	95.0	96.1	96.5	98.9	99.8	100.0
Girls													
12-17 years	3.8	40.4	65.8	81.5	88.0	90.4	92.8	94.3	96.0	97.5	99.2	99.8	100.0
12 years	2.1	38.3	62.1	81.1	89.6	92.5	94.3	95.9	97.0	97.8	99.4	99.7	100.0
13 years	4.1	36.9	63.0	80.6	86.7	90.2	91.8	93.4	95.4	97.4	99.3	99.9	100.0
14 years	2.8	41.5	65.8	82.0	87.6	89.0	92.5	94.2	96.7	98.3	99.5	100.0	100.0
15 years	4.9	40.8	67.5	82.2	89.4	91.3	93.4	94.9	96.6	98.2	99.6	99.8	100.0
16 years	5.6	43.7	68.2	81.2	86.0	87.5	91.7	93.6	95.0	96.7	99.1	99.7	100.0
17 years	3.7	42.0	68.7	81.6	88.1	91.6	93.0	93.9	95.7	97.0	98.6	99.8	100.0

Table 4. Percent of youths of 12-17 years reaching or reaching and exceeding specified acuity levels in the better eye for monocular distance vision without correction, by age and sex, with standard errors for totals: United States, 1966-70

Age and sex	Acuity level - Snellen ratio												
	20/12 or better	20/15	20/17	20/20	20/25	20/30	20/40	20/50	20/70	20/100	20/200	20/400	Less than 20/400
Both sexes	Percent of youths												
12-17 years----	5.6	28.0	16.3	13.7	7.2	3.2	3.6	2.8	4.5	3.6	6.1	3.9	1.5
Standard error of total------	0.35	0.61	0.67	0.40	0.37	0.25	0.26	0.18	0.28	0.25	0.41	0.35	0.19
12 years----------	4.4	25.1	18.0	15.5	10.7	3.0	4.6	3.1	4.0	3.9	4.5	2.4	0.8
13 years----------	4.4	27.0	16.0	15.4	7.3	3.6	4.2	3.0	5.0	3.9	5.6	3.5	1.1
14 years----------	4.3	30.1	17.6	12.7	6.5	3.5	3.0	2.6	3.6	2.7	6.9	4.4	2.1
15 years----------	6.4	27.8	15.7	13.9	8.0	2.7	3.9	2.8	4.1	4.0	6.3	3.1	1.3
16 years----------	7.2	27.9	15.7	13.5	5.2	2.7	2.9	2.3	4.4	3.9	6.9	5.7	1.7
17 years----------	7.2	30.5	14.4	10.8	5.3	3.7	2.7	2.9	6.1	3.2	6.6	4.4	2.2
Boys													
12-17 years----	7.5	31.3	15.8	13.3	6.9	2.9	3.0	2.4	3.8	3.3	5.4	3.2	1.2
Standard error of total------	0.47	1.00	0.71	0.56	0.50	0.35	0.28	0.33	0.36	0.38	0.38	0.35	0.18
12 years----------	6.1	28.2	17.2	15.6	10.9	2.3	3.0	2.6	3.4	4.1	4.2	1.7	0.7
13 years----------	4.6	30.9	16.5	17.0	7.0	3.3	3.8	2.3	3.4	3.6	4.9	2.4	0.3
14 years----------	5.3	32.8	18.4	12.8	6.0	3.9	2.7	2.3	3.1	1.8	4.4	3.9	2.6
15 years----------	9.2	30.0	13.5	12.8	7.8	2.2	3.2	2.5	3.6	4.1	7.2	2.6	1.3
16 years----------	9.6	32.9	13.1	10.4	5.6	2.5	2.5	2.5	5.1	3.2	6.8	4.8	1.0
17 years----------	10.6	33.0	15.3	10.5	3.7	3.4	3.1	2.0	4.3	3.0	5.4	4.4	1.3
Girls													
12-17 years----	3.7	24.6	16.8	14.1	7.6	3.5	4.1	3.2	5.3	3.9	6.8	4.6	1.8
Standard error of total------	0.47	0.78	0.90	0.82	0.41	0.35	0.37	0.26	0.40	0.33	0.53	0.56	0.32
12 years----------	2.8	21.7	18.8	15.4	10.5	3.7	6.1	3.7	4.7	3.7	4.8	3.2	0.9
13 years----------	4.3	22.9	15.2	13.7	7.7	4.0	4.7	3.6	6.7	4.2	6.3	4.7	2.0
14 years----------	3.2	27.0	16.9	12.6	7.1	3.1	3.4	2.8	4.0	3.7	9.6	5.0	1.6
15 years----------	3.6	25.4	17.8	15.1	8.3	3.2	4.6	3.2	4.6	3.9	5.3	3.6	1.4
16 years----------	4.7	22.6	18.3	16.8	4.8	3.0	3.3	2.1	3.8	4.6	7.0	6.7	2.3
17 years----------	3.6	28.3	13.4	11.1	6.8	4.1	2.4	3.8	7.9	3.3	7.8	4.4	3.1
Both sexes	Cumulative percent												
12-17 years----	5.6	33.6	49.9	63.6	70.8	74.0	77.6	80.4	84.9	88.5	94.6	98.5	100.0
12 years----------	4.4	29.5	47.5	63.0	73.7	76.7	81.3	84.4	88.4	92.3	96.8	99.2	100.0
13 years----------	4.4	31.4	47.4	62.8	70.1	73.7	77.9	80.9	85.9	89.8	95.4	98.9	100.0
14 years----------	4.3	34.4	52.0	64.7	71.2	74.7	77.7	80.3	83.9	86.6	93.5	97.9	100.0
15 years----------	6.4	34.2	49.9	63.8	71.8	74.5	78.4	81.2	85.3	89.3	95.6	98.7	100.0
16 years----------	7.2	35.1	50.8	64.3	69.5	72.2	75.1	77.4	81.8	85.7	92.6	98.3	100.0
17 years----------	7.2	37.7	52.1	62.9	68.2	71.9	74.6	77.5	83.6	86.8	93.4	97.8	100.0
Boys													
12-17 years----	7.5	38.8	54.6	67.9	74.8	77.7	80.7	83.1	86.9	90.2	95.6	98.8	100.0
12 years----------	6.1	34.3	51.5	67.1	78.0	80.3	83.3	85.9	89.3	93.4	97.6	99.3	100.0
13 years----------	4.6	35.5	52.0	69.0	76.0	79.3	83.1	85.4	88.8	92.4	97.3	99.7	100.0
14 years----------	5.3	38.1	56.5	69.3	75.3	79.2	81.9	84.2	87.3	89.1	93.5	97.4	100.0
15 years----------	9.2	39.2	52.7	65.5	73.3	75.5	78.7	81.2	84.8	88.9	96.1	98.7	100.0
16 years----------	9.6	42.5	55.6	66.0	71.6	74.1	76.6	79.1	84.2	87.4	94.2	99.0	100.0
17 years----------	10.6	43.6	58.9	69.4	73.1	76.5	79.6	81.6	85.9	88.9	94.3	98.7	100.0
Girls													
12-17 years----	3.7	28.3	45.1	59.2	66.8	70.3	74.4	77.6	82.9	86.8	93.6	98.2	100.0
12 years----------	2.8	24.5	43.3	58.7	69.2	72.9	79.0	82.7	87.4	91.1	95.9	99.1	100.0
13 years----------	4.3	27.2	42.4	56.1	63.8	67.8	72.5	76.1	82.8	87.0	93.3	98.0	100.0
14 years----------	3.2	30.2	47.1	59.7	66.8	69.9	73.3	76.1	80.1	83.8	93.4	98.4	100.0
15 years----------	3.6	29.0	46.8	61.9	70.2	73.4	78.0	81.2	85.8	89.7	95.0	98.6	100.0
16 years----------	4.7	27.3	45.6	62.4	67.2	70.2	73.5	75.6	79.4	84.0	91.0	97.7	100.0
17 years----------	3.6	31.9	45.3	56.4	63.2	67.3	69.7	73.5	81.4	84.7	92.5	96.9	100.0

Table 5. Percent of youths of 12-17 years reaching specified acuity levels in the right and left eye for monocular distance vision without correction, by age and sex, with standard errors for totals: United States, 1966-70

Age and sex	Acuity level - Snellen ratio												
	20/12 or better	20/15	21/17	20/20	20/25	20/30	20/40	20/50	20/70	20/100	20/200	20/400	Less than 20/400
	Percent of youths												
RIGHT EYE													
Both sexes													
12-17 years	3.6	21.2	15.9	16.9	7.9	3.8	4.0	3.4	4.7	4.4	7.2	4.3	2.7
Standard error of total	0.34	0.57	0.64	0.48	0.40	0.26	0.29	0.20	0.25	0.25	0.43	0.34	0.28
12 years	2.6	16.9	17.6	19.5	11.4	4.6	4.5	3.1	4.9	4.4	6.0	3.1	1.4
13 years	2.2	19.7	16.8	17.1	8.9	3.8	4.8	3.4	5.9	4.5	7.1	3.5	2.3
14 years	2.9	22.7	16.0	17.0	7.2	3.5	3.4	3.5	3.7	4.0	7.9	4.7	3.5
15 years	4.6	21.9	15.3	16.2	7.7	4.2	4.8	2.9	4.3	4.5	7.7	3.3	2.6
16 years	4.8	22.0	15.5	16.1	5.9	2.4	3.8	4.2	4.1	4.3	7.2	6.5	3.2
17 years	4.7	24.5	13.5	14.8	5.7	4.2	2.7	3.5	5.5	4.5	7.7	5.0	3.7
Boys													
12-17 years	4.9	24.5	16.3	16.6	7.8	3.6	3.5	2.9	3.8	4.0	6.3	3.4	2.4
Standard error of total	0.37	0.75	0.83	0.59	0.51	0.30	0.32	0.28	0.35	0.26	0.42	0.29	0.29
12 years	3.7	20.0	17.8	20.0	11.2	4.6	3.2	2.5	3.9	3.9	5.6	2.4	1.2
13 years	2.3	23.2	17.7	17.4	9.3	4.3	4.9	2.5	3.9	4.6	6.5	2.2	1.2
14 years	3.5	25.1	17.2	18.2	7.4	3.9	2.7	3.3	2.4	3.5	4.9	3.6	4.3
15 years	6.4	25.0	13.7	15.0	7.7	3.7	4.7	2.8	3.6	4.0	7.8	3.1	2.5
16 years	6.9	26.2	15.3	13.7	6.5	2.1	2.6	3.8	3.6	4.6	7.4	5.3	2.0
17 years	7.2	27.5	15.7	14.5	4.3	2.8	3.0	2.9	5.5	3.2	5.8	4.3	3.3
Girls													
12-17 years	2.3	17.8	15.4	17.1	8.0	4.0	4.5	3.9	5.7	4.8	8.2	5.2	3.1
Standard error of total	0.41	0.79	0.86	0.87	0.45	0.41	0.44	0.33	0.43	0.39	0.72	0.54	0.42
12 years	1.6	13.6	17.5	18.8	11.7	4.4	5.8	3.8	6.0	5.0	6.5	3.7	1.6
13 years	2.1	16.3	15.9	16.9	8.4	3.2	4.8	4.2	7.9	4.3	7.7	4.9	3.4
14 years	2.2	20.1	14.7	16.0	7.0	3.1	4.1	3.6	5.1	4.6	10.9	5.9	2.7
15 years	2.9	18.6	16.9	17.5	7.6	4.7	5.0	3.0	5.1	4.9	7.5	3.6	2.7
16 years	2.7	17.5	15.8	18.6	5.4	2.8	5.0	4.6	4.6	3.9	7.0	7.7	4.4
17 years	2.2	21.4	11.3	15.1	7.2	5.6	2.4	4.1	5.5	5.8	9.7	5.6	4.1
LEFT EYE													
Both sexes													
12-17 years	3.3	22.5	15.6	14.3	9.2	4.3	4.3	3.4	4.6	4.1	7.6	4.2	2.6
Standard error of total	0.21	0.69	0.64	0.52	0.40	0.28	0.29	0.22	0.26	0.26	0.51	0.33	0.23
12 years	2.8	20.0	16.6	16.3	12.3	3.2	5.8	3.3	4.8	4.2	6.9	2.2	1.6
13 years	3.4	20.6	15.2	16.5	9.2	4.8	4.4	3.1	4.9	4.9	6.8	4.5	1.7
14 years	2.3	23.3	17.7	14.8	7.2	5.8	3.8	2.9	3.7	2.9	7.6	4.8	3.2
15 years	3.4	23.5	15.2	12.1	11.5	3.7	4.1	3.9	3.9	4.8	7.6	3.7	2.6
16 years	4.4	22.3	14.6	13.1	8.5	4.8	3.4	2.4	4.4	4.3	8.8	5.9	3.1
17 years	3.8	25.4	14.3	12.5	6.0	3.7	3.9	4.7	6.0	3.8	7.8	4.3	3.8
Boys													
12-17 years	4.5	25.7	16.2	14.0	8.9	3.8	3.8	3.0	4.1	3.4	7.1	3.2	1.3
Standard error of total	0.38	0.96	0.67	0.57	0.50	0.38	0.29	0.20	0.31	0.30	0.44	0.35	0.27
12 years	4.0	22.6	17.0	16.3	12.5	2.1	4.6	3.7	3.9	3.4	7.2	1.3	1.4
13 years	3.4	23.5	16.7	18.1	9.8	4.6	3.6	2.6	4.0	4.3	5.9	2.8	0.7
14 years	3.4	26.0	18.7	14.5	6.8	6.1	3.9	3.0	3.3	1.6	5.5	4.0	3.2
15 years	5.4	25.3	14.3	12.1	10.2	3.4	3.1	3.5	4.0	4.5	8.1	3.2	2.9
16 years	5.8	26.5	15.1	10.6	7.8	4.2	3.3	1.8	5.2	3.4	8.9	5.0	2.4
17 years	5.5	30.6	14.4	12.2	5.8	2.7	4.1	3.4	4.1	3.1	7.3	3.5	3.3
Girls													
12-17 years	2.1	19.3	15.2	14.5	9.5	4.8	4.8	3.7	5.1	4.9	8.0	5.1	3.0
Standard error of total	0.26	0.85	0.84	0.82	0.52	0.34	0.44	0.37	0.46	0.46	0.70	0.56	0.35
12 years	1.5	17.5	16.3	16.2	12.1	4.3	7.0	2.8	5.7	5.0	6.7	3.1	1.8
13 years	3.3	17.5	13.5	15.0	8.6	5.0	5.3	3.7	5.7	5.6	7.8	6.2	2.8
14 years	1.2	20.5	16.6	15.2	7.6	5.4	3.8	2.8	4.0	4.3	9.8	5.6	3.2
15 years	1.5	21.2	16.1	12.2	12.9	4.1	5.2	4.4	3.8	5.1	7.1	4.2	2.2
16 years	2.9	18.2	14.2	15.6	9.3	5.4	3.4	2.9	3.6	5.2	8.7	6.9	3.7
17 years	2.1	20.3	14.3	12.8	6.2	4.6	3.8	6.0	8.0	4.4	8.2	5.1	4.2

Table 6. Percent of youths of 12-17 years reaching or reaching and exceeding specified acuity levels in the better eye for monocular near vision without correction, by age and sex, with standard errors for totals: United States, 1966-70

Age and sex	Acuity level - Snellen ratio												
	13/7.8 or better	13/9.75	13/11.05	13/13	13/16.25	13/19.5	13/26	13/32.5	13/45.5	13/65	13/130	13/260	Less than 13/260
	Percent of youths												
Both sexes													
12-17 years---	1.9	29.4	24.8	24.1	8.5	2.5	2.2	1.3	1.4	1.4	1.7	0.6	0.2
Standard error of total-----	0.19	0.57	0.62	0.56	0.34	0.23	0.18	0.14	0.15	0.11	0.19	0.15	0.07
12 years----------	1.5	26.0	24.1	27.3	10.7	3.0	2.5	1.3	1.1	0.8	1.1	0.4	0.2
13 years----------	1.4	26.4	26.2	26.9	8.1	3.0	1.6	0.9	2.0	1.2	1.8	0.5	-
14 years----------	1.5	30.9	23.3	23.5	8.7	2.1	2.7	1.3	1.2	2.0	2.0	0.4	0.4
15 years----------	1.9	30.2	24.2	23.6	9.1	2.4	3.1	1.1	1.1	1.3	1.4	0.3	0.3
16 years----------	3.2	31.3	23.4	22.9	6.8	2.2	1.5	2.1	2.0	1.5	2.1	0.8	0.2
17 years----------	2.0	32.1	27.0	19.9	7.6	2.0	2.0	1.3	1.1	1.6	2.0	1.3	0.1
Boys													
12-17 years---	2.8	33.0	24.7	21.8	7.8	2.4	2.1	1.0	1.0	1.1	1.5	0.6	0.2
Standard error of total-----	0.42	0.94	0.73	0.77	0.53	0.24	0.20	0.15	0.17	0.15	0.27	0.18	0.07
12 years----------	2.2	29.1	25.0	26.0	9.2	2.2	2.7	1.2	0.9	0.4	0.7	0.3	0.1
13 years----------	1.6	29.8	28.4	24.5	7.1	2.9	1.5	0.7	0.8	1.6	1.0	0.1	-
14 years----------	2.4	34.1	24.4	19.8	8.3	2.3	2.2	0.6	0.5	1.6	2.7	0.7	0.4
15 years----------	2.9	33.4	23.3	21.6	8.2	2.9	3.5	0.4	1.1	0.9	1.2	0.2	0.4
16 years----------	5.0	34.4	23.8	19.6	6.5	2.6	1.1	1.2	1.9	1.2	1.4	1.0	0.3
17 years----------	2.5	38.7	23.0	18.9	7.1	1.7	1.3	1.8	0.5	1.0	2.1	1.4	-
Girls													
12-17 years---	1.0	25.6	24.6	26.5	9.3	2.5	2.4	1.7	1.9	1.7	2.0	0.6	0.2
Standard error of total-----	0.12	0.63	0.85	0.71	0.54	0.35	0.27	0.21	0.23	0.19	0.23	0.20	0.13
12 years----------	0.6	22.9	23.2	28.5	12.3	3.8	2.4	1.5	1.4	1.2	1.4	0.5	0.3
13 years----------	1.2	23.0	23.8	29.3	9.2	3.2	1.7	1.1	3.1	0.8	2.7	0.9	-
14 years----------	0.5	27.6	22.2	27.0	9.0	2.0	3.2	2.1	2.0	2.4	1.4	0.1	0.5
15 years----------	1.0	26.7	25.1	25.7	10.0	1.8	2.6	1.9	1.1	1.8	1.6	0.5	0.2
16 years----------	1.2	28.2	23.0	26.3	7.0	1.9	1.9	3.0	2.2	1.8	2.8	0.6	0.1
17 years----------	1.4	25.2	31.1	21.0	8.1	2.4	2.7	0.8	1.7	2.3	1.8	1.3	0.2
	Cumulative percent												
Both sexes													
12-17 years---	1.9	31.3	56.1	80.2	88.7	91.2	93.4	94.7	96.1	97.5	99.2	99.8	100.0
12 years----------	1.5	27.5	51.6	78.9	89.6	92.6	95.1	96.4	97.5	98.3	99.4	99.8	100.0
13 years----------	1.4	27.8	54.0	80.9	89.0	92.0	93.6	94.5	96.5	97.7	99.5	100.0	100.0
14 years----------	1.5	32.4	55.7	79.2	87.9	90.0	92.7	94.0	95.2	97.2	99.2	99.6	100.0
15 years----------	1.9	32.1	56.3	79.9	89.0	91.4	94.5	95.6	96.7	98.0	99.4	99.7	100.0
16 years----------	3.2	34.5	57.9	80.8	87.6	89.8	91.3	93.4	95.4	96.9	99.0	99.8	100.0
17 years----------	2.0	34.1	61.1	81.0	88.6	90.6	92.6	93.9	95.0	96.6	98.6	99.9	100.0
Boys													
12-17 years---	2.8	35.8	60.5	82.3	90.1	92.5	94.6	95.6	96.6	97.7	99.2	99.8	100.0
12 years----------	2.2	31.3	56.3	82.3	91.5	93.7	96.4	97.6	98.5	98.9	99.6	99.9	100.0
13 years----------	1.6	31.4	59.8	84.3	91.4	94.3	95.8	96.5	97.3	98.9	99.9	100.0	100.0
14 years----------	2.4	36.5	60.9	80.7	89.0	91.3	93.5	94.1	94.6	96.2	98.9	99.6	100.0
15 years----------	2.9	36.3	59.6	81.2	89.4	92.3	95.8	96.2	97.3	98.2	99.4	99.6	100.0
16 years----------	5.0	39.4	63.2	82.8	89.3	91.9	93.0	94.2	96.1	97.3	98.7	99.7	100.0
17 years----------	2.5	41.2	64.2	83.1	90.2	91.9	93.2	95.0	95.5	96.5	98.6	100.0	100.0
Girls													
12-17 years---	1.0	26.6	51.2	77.7	87.0	89.5	91.9	93.6	95.5	97.2	99.2	99.8	100.0
12 years----------	0.6	23.5	46.7	75.2	87.5	91.3	93.7	95.2	96.6	97.8	99.2	99.7	100.0
13 years----------	1.2	24.2	48.0	77.3	86.5	89.7	91.4	92.5	95.6	96.4	99.1	100.0	100.0
14 years----------	0.5	28.1	50.3	77.3	86.3	88.3	91.5	93.6	95.6	98.0	99.4	99.5	100.0
15 years----------	1.0	27.7	52.8	78.5	88.5	90.3	92.9	94.8	95.9	97.7	99.3	99.8	100.0
16 years----------	1.2	29.4	52.4	78.7	85.7	87.6	89.5	92.5	94.7	96.5	99.3	99.9	100.0
17 years----------	1.4	26.6	57.7	78.7	86.8	89.2	91.9	92.7	94.4	96.7	98.5	99.8	100.0

Table 7. Percent of youths of 12-17 years reaching specified acuity levels in the left and right eye for monocular near vision without correction, by age and sex, with standard errors for totals: United States, 1966-70

Age and sex	Acuity level - Snellen ratio												
	13/7.8 or better	13/9.75	13/11.05	13/13	13/16.25	13/19.5	13/26	13/32.5	13/45.5	13/65	13/130	13/260	Less than 13/260
RIGHT EYE	Percent of youths												
Both sexes													
12-17 years---	1.4	20.2	26.7	22.9	12.7	3.9	3.0	1.7	1.9	1.7	2.2	1.0	0.7
Standard error of total---	0.20	0.69	0.54	0.67	0.33	0.27	0.22	0.19	0.16	0.17	0.20	0.12	0.15
12 years---	0.8	18.0	25.9	23.2	16.3	4.5	3.4	1.8	1.7	1.5	1.3	0.6	1.0
13 years---	1.2	17.3	27.1	25.8	13.2	3.9	2.9	1.4	2.2	1.3	2.3	0.6	0.8
14 years---	1.0	20.9	25.9	22.1	12.6	4.0	2.5	1.7	2.2	2.3	3.3	0.9	0.6
15 years---	1.3	21.1	25.8	22.7	14.0	4.2	3.8	1.2	1.4	1.6	1.4	1.0	0.5
16 years---	2.3	21.9	25.7	23.1	9.9	3.3	2.8	2.2	2.5	1.5	2.7	1.4	0.7
17 years---	1.5	22.5	30.2	20.2	9.4	3.3	2.3	2.1	1.4	2.3	2.5	1.5	0.8
Boys													
12-17 years---	2.0	22.6	27.8	21.6	11.4	3.6	3.0	1.5	1.5	1.4	2.2	0.8	0.6
Standard error of total---	0.38	1.00	0.76	0.99	0.65	0.33	0.34	0.21	0.20	0.17	0.25	0.19	0.13
12 years---	1.4	20.5	26.8	23.3	14.2	3.3	4.0	1.6	1.4	1.5	0.8	0.5	0.7
13 years---	1.5	18.2	30.6	24.4	11.7	4.1	3.0	1.2	1.4	1.5	1.7	0.4	0.3
14 years---	1.4	23.2	28.5	20.2	11.3	3.0	2.0	1.6	1.7	1.2	4.1	1.4	0.6
15 years---	2.3	22.3	26.4	21.2	12.0	4.5	5.5	0.6	1.1	1.3	1.6	0.6	0.6
16 years---	3.7	24.0	26.1	22.2	9.3	3.9	1.8	1.7	2.2	1.3	1.7	0.9	1.2
17 years---	2.1	28.3	28.3	17.9	9.4	2.6	1.4	2.4	1.3	1.2	3.2	1.3	0.6
Girls													
12-17 years---	0.6	17.7	25.7	24.3	14.0	4.2	2.9	2.0	2.3	2.1	2.3	1.1	0.8
Standard error of total---	0.12	0.68	0.64	0.77	0.66	0.45	0.31	0.26	0.30	0.28	0.26	0.18	0.29
12 years---	0.3	15.5	24.9	22.8	18.5	5.7	2.8	2.0	2.0	1.6	1.9	0.8	1.2
13 years---	1.0	16.4	23.2	27.2	14.7	3.8	2.9	1.7	3.1	1.1	2.8	0.8	1.3
14 years---	0.5	18.7	23.6	24.2	13.9	5.0	2.9	1.7	2.7	3.3	2.5	0.4	0.6
15 years---	0.3	19.9	25.0	24.3	16.0	3.9	2.1	1.9	1.8	1.8	1.3	1.3	0.4
16 years---	0.8	19.7	25.8	24.1	10.5	2.7	3.7	2.7	2.7	1.7	3.6	1.9	0.1
17 years---	1.0	16.5	32.1	22.6	9.5	4.0	3.2	1.7	1.5	3.4	1.8	1.6	1.1
LEFT EYE													
Both sexes													
12-17 years---	0.8	20.6	17.7	31.5	13.0	3.7	3.0	2.0	2.0	2.0	2.2	0.9	0.6
Standard error of total---	0.13	0.56	0.60	0.70	0.52	0.27	0.16	0.13	0.14	0.13	0.18	0.16	0.12
12 years---	0.7	17.8	17.2	34.6	14.3	3.6	3.7	2.3	2.0	1.6	1.4	0.4	0.4
13 years---	0.5	19.0	18.7	32.3	13.8	4.5	2.4	1.4	1.7	2.1	2.5	0.9	0.2
14 years---	0.7	21.3	17.8	31.6	12.7	3.8	2.4	1.9	1.7	2.1	2.3	0.5	1.2
15 years---	0.9	21.6	16.6	30.6	13.2	3.9	4.2	2.0	1.9	1.9	1.8	0.6	0.8
16 years---	1.4	21.4	18.0	30.5	11.5	3.4	2.5	2.2	2.6	2.1	2.4	1.6	0.4
17 years---	0.9	23.0	18.1	29.2	12.0	2.9	2.9	2.4	2.1	1.8	2.7	1.5	0.5
Boys													
12-17 years---	1.2	24.4	18.0	29.8	12.3	3.7	2.5	1.5	1.8	1.4	2.0	0.8	0.6
Standard error of total---	0.26	0.86	0.83	0.86	0.68	0.27	0.22	0.20	0.22	0.20	0.23	0.18	0.13
12 years---	1.0	20.9	17.8	33.2	13.4	3.5	3.5	1.9	1.6	1.4	1.0	0.6	0.2
13 years---	0.7	22.9	20.7	30.0	12.7	5.0	1.7	1.1	1.2	2.1	1.5	0.4	-
14 years---	1.4	23.8	17.7	28.8	13.7	3.9	2.2	1.3	0.9	1.6	2.9	0.6	1.2
15 years---	0.9	24.8	16.5	29.5	12.4	3.8	3.3	1.8	2.6	1.2	1.6	0.3	1.3
16 years---	2.3	24.8	18.7	27.6	10.9	3.9	2.0	1.4	2.5	1.5	2.2	1.7	0.5
17 years---	1.3	29.6	16.3	28.6	10.2	1.9	2.2	1.8	2.0	0.8	2.9	1.7	0.7
Girls													
12-17 years---	0.4	16.8	17.5	33.3	13.7	3.7	3.5	2.5	2.2	2.5	2.4	1.0	0.5
Standard error of total---	0.09	0.72	0.82	0.77	0.59	0.42	0.28	0.32	0.26	0.20	0.22	0.24	0.19
12 years---	0.3	14.6	16.5	36.0	15.3	3.6	3.9	2.8	2.4	1.9	1.7	0.3	0.7
13 years---	0.3	15.2	16.7	34.6	14.9	4.0	3.0	1.6	2.3	2.2	3.5	1.4	0.3
14 years---	-	18.5	18.0	34.4	11.6	3.7	2.7	2.5	2.5	2.7	1.8	0.5	1.1
15 years---	0.8	18.3	16.6	31.5	14.1	4.0	5.0	2.2	1.2	2.8	2.2	0.9	0.4
16 years---	0.6	18.0	17.4	33.3	12.2	2.8	3.0	3.0	2.6	2.7	2.6	1.5	0.3
17 years---	0.4	16.5	20.0	29.8	13.7	3.8	3.5	3.0	2.2	2.8	2.6	1.3	0.4

Table 8. Percent of youths of 12-17 years reaching or reaching and exceeding specified acuity levels for corrected binocular distance vision (with own lenses), by age and sex, with standard errors for totals: United States, 1966-70

Age and sex	Acvity level - Snellen ratio (with own lenses)												
	20/12 or better	20/15	20/17	20/20	20/25	20/30	20/40	20/50	20/70	20/100	20/200	20/400	Less than 20/400
	Percent of youths												
Both sexes													
12-17 years----	13.1	38.2	20.0	16.3	6.6	2.3	2.0	0.7	0.6	0.1	0.0	0.1	-
Standard error of total------	0.96	1.51	1.07	0.77	0.77	0.36	0.43	0.17	0.23	0.08	0.04	0.06	-
12 years----------	10.0	29.4	18.8	20.5	12.1	3.3	2.8	2.1	1.0	-	-	-	-
13 years----------	6.8	34.2	25.5	16.1	10.3	2.1	2.7	1.2	0.7	0.4	-	-	-
14 years----------	11.6	38.2	19.8	17.1	5.4	2.7	2.1	0.6	1.7	-	0.2	0.6	-
15 years----------	13.3	39.2	19.3	18.4	4.7	2.5	2.6	-	-	-	-	-	-
16 years----------	15.3	41.4	19.1	14.7	5.1	2.7	0.4	0.4	0.6	0.3	-	-	-
17 years----------	20.0	44.4	17.7	12.0	3.3	0.9	1.4	0.3	-	-	-	-	-
Boys													
12-17 years----	18.0	35.8	17.2	15.9	6.9	2.9	1.9	0.6	0.5	-	0.1	0.2	-
Standard error of total------	2.01	2.16	1.20	1.44	1.27	0.61	0.66	0.22	0.36	-	0.10	0.15	-
12 years----------	13.1	31.4	18.5	17.5	10.8	4.5	1.1	2.2	0.9	-	-	-	-
13 years----------	12.0	31.8	22.5	16.0	9.0	3.4	3.0	0.9	1.4	-	-	-	-
14 years----------	13.3	34.0	16.6	16.8	11.0	2.6	3.4	-	-	-	0.7	1.6	-
15 years----------	14.0	37.7	15.6	21.7	4.2	3.5	3.3	-	-	-	-	-	-
16 years----------	25.2	36.6	15.0	12.8	6.4	2.8	-	0.4	0.8	-	-	-	-
17 years----------	27.6	42.3	16.3	10.6	1.4	0.7	1.1	-	-	-	-	-	-
Girls													
12-17 years----	9.7	39.6	21.9	16.6	6.4	2.0	2.0	0.8	0.8	0.2	-	-	-
Standard error of total------	0.96	1.86	1.36	1.15	0.79	0.45	0.59	0.27	0.23	0.15	-	-	-
12 years----------	7.3	27.7	19.1	23.1	13.1	2.3	4.2	2.0	1.2	-	-	-	-
13 years----------	3.7	35.5	27.3	16.1	11.0	1.3	2.6	1.4	0.4	0.7	-	-	-
14 years----------	10.5	40.8	21.9	17.3	1.8	2.7	1.2	1.0	2.8	-	-	-	-
15 years----------	12.7	40.3	22.3	15.7	5.2	1.7	2.1	-	-	-	-	-	-
16 years----------	8.2	44.8	22.0	16.1	4.2	2.6	0.7	0.4	0.4	0.6	-	-	-
17 years----------	15.1	45.7	18.6	12.9	4.5	1.1	1.6	0.5	-	-	-	-	-
	Cumulative percent												
Both sexes													
12-17 years----	13.1	51.3	71.3	87.6	94.2	96.5	98.5	99.2	99.8	99.9	99.9	100.0	100.0
12 years----------	10.0	39.4	58.2	78.7	90.8	94.1	96.9	99.0	100.0	100.0	100.0	100.0	100.0
13 years----------	6.8	41.0	66.5	82.6	92.9	95.0	97.7	98.9	99.6	100.0	100.0	100.0	100.0
14 years----------	11.6	49.8	69.6	86.7	92.1	94.8	96.9	97.5	99.2	99.2	99.4	100.0	100.0
15 years----------	13.3	52.5	71.8	90.2	94.9	97.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0
16 years----------	15.3	56.7	75.8	90.5	95.6	98.3	98.7	99.1	99.7	100.0	100.0	100.0	100.0
17 years----------	20.0	64.4	82.1	94.1	97.4	98.3	99.7	100.0	100.0	100.0	100.0	100.0	100.0
Boys													
12-17 years----	18.0	53.8	71.0	86.9	93.8	96.7	98.6	99.2	99.7	99.7	99.8	100.0	100.0
12 years----------	13.1	44.5	63.0	80.5	91.3	95.8	96.9	99.1	100.0	100.0	100.0	100.0	100.0
13 years----------	12.0	43.8	66.3	82.3	91.3	94.7	97.7	98.6	100.0	100.0	100.0	100.0	100.0
14 years----------	13.3	47.3	63.9	80.7	91.7	94.3	97.7	97.7	97.7	97.7	98.4	100.0	100.0
15 years----------	14.0	51.7	67.3	89.0	93.2	96.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0
16 years----------	25.2	61.8	76.8	89.6	96.0	98.8	98.8	99.2	100.0	100.0	100.0	100.0	100.0
17 years----------	27.6	69.9	86.2	96.8	98.2	98.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Girls													
12-17 years----	9.7	49.3	71.2	87.8	94.2	96.2	98.2	99.0	99.8	100.0	100.0	100.0	100.0
12 years----------	7.3	35.0	54.1	77.2	90.3	92.6	96.8	98.8	100.0	100.0	100.0	100.0	100.0
13 years----------	3.7	39.2	66.5	82.6	93.6	94.9	97.5	98.9	99.3	100.0	100.0	100.0	100.0
14 years----------	10.5	51.3	73.2	90.5	92.3	95.0	96.2	97.2	100.0	100.0	100.0	100.0	100.0
15 years----------	12.7	53.0	75.3	91.0	96.2	97.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0
16 years----------	8.2	53.0	75.0	91.1	95.3	97.9	98.6	99.0	99.4	100.0	100.0	100.0	100.0
17 years----------	15.1	60.8	79.4	92.3	96.8	97.9	99.5	100.0	100.0	100.0	100.0	100.0	100.0

Table 9. Percent of youths of 12-17 years reaching or reaching and exceeding specified acuity levels for binocular distance vision "with usual correction," by age and sex, with standard errors for totals: United States, 1966-70

Age and sex	Acuity level - "with usual correction" Snellen ratio												
	20/12 or better	20/15	20/17	20/20	20/25	20/30	20/40	20/50	20/70	20/100	20/200	20/400	Less than 20/400
	Percent of youths												
Both sexes													
12-17 years	18.6	40.3	17.5	11.8	5.0	1.8	1.7	1.2	1.2	0.4	0.2	0.2	0.1
Standard error of total	0.87	1.07	0.47	0.35	0.37	0.25	0.19	0.14	0.15	0.10	0.05	0.05	0.03
12 years	13.4	38.8	18.4	14.0	7.3	2.1	1.9	1.7	1.6	0.4	0.3	0.1	0.0
13 years	13.9	39.5	20.4	12.0	6.1	1.5	2.4	1.3	2.0	0.4	0.2	0.2	0.1
14 years	17.4	41.8	17.4	11.1	4.9	1.8	2.2	1.0	1.0	0.6	0.4	0.4	-
15 years	20.7	38.3	17.7	12.3	4.2	2.2	2.0	1.1	0.9	0.2	0.1	0.3	-
16 years	21.8	41.4	17.3	10.6	3.9	1.9	0.7	0.9	1.0	0.3	-	-	0.2
17 years	26.1	42.8	13.3	10.8	3.0	1.0	0.6	1.2	0.6	0.6	-	-	-
Boys													
12-17 years	23.4	40.1	15.3	10.8	4.6	1.9	1.2	1.0	0.9	0.4	0.1	0.2	0.1
Standard error of total	1.10	1.47	0.46	0.57	0.42	0.38	0.20	0.16	0.20	0.12	0.05	0.07	0.05
12 years	17.4	40.6	16.8	12.8	6.4	2.0	0.7	1.9	1.1	0.2	-	-	0.1
13 years	16.6	41.2	19.6	10.7	4.8	1.5	2.2	0.9	2.1	0.3	-	-	0.1
14 years	19.1	42.0	16.0	10.4	5.4	2.5	2.3	0.3	0.4	0.4	0.4	0.8	-
15 years	26.7	36.7	14.2	12.2	4.0	2.8	1.4	0.9	0.6	0.2	-	0.3	-
16 years	28.8	40.8	13.5	8.3	3.9	1.8	0.4	1.1	0.6	0.4	-	-	0.4
17 years	33.2	39.8	11.0	10.1	2.6	0.9	0.3	0.8	0.7	0.6	-	-	-
Girls													
12-17 years	13.9	40.5	19.8	12.9	5.4	1.6	2.1	1.4	1.5	0.5	0.3	0.1	-
Standard error of total	0.87	0.98	0.64	0.42	0.44	0.27	0.23	0.19	0.24	0.11	0.08	0.07	-
12 years	9.2	36.6	20.1	15.2	8.3	2.3	3.2	1.5	2.2	0.6	0.6	0.2	-
13 years	11.1	37.9	21.2	13.3	7.4	1.6	2.6	1.7	1.9	0.5	0.5	0.3	-
14 years	15.7	41.5	18.8	11.8	4.5	1.1	2.1	1.7	1.7	0.8	0.3	-	-
15 years	14.6	40.2	21.3	12.4	4.4	1.5	2.6	1.2	1.2	0.1	0.2	0.3	-
16 years	14.6	42.1	21.2	13.0	3.8	2.1	1.1	0.6	1.3	0.2	-	-	-
17 years	19.1	46.2	15.6	11.4	3.3	1.1	0.8	1.6	0.4	0.5	-	-	-
	Cumulative percent												
Both sexes													
12-17 years	18.6	58.9	76.4	88.2	93.2	95.0	96.7	97.9	99.1	99.5	99.7	99.9	100.0
12 years	13.4	52.2	70.6	84.6	91.9	94.0	95.9	97.6	99.2	99.6	99.9	100.0	100.0
13 years	13.9	53.4	73.8	85.8	91.9	93.4	95.8	97.1	99.1	99.5	99.7	99.9	100.0
14 years	17.4	59.2	76.6	87.7	92.6	94.4	96.6	97.6	98.6	99.2	99.6	100.0	100.0
15 years	20.7	59.0	76.7	89.0	93.2	95.4	97.4	98.5	99.4	99.6	99.7	100.0	100.0
16 years	21.8	63.2	80.5	91.1	95.0	96.9	97.6	98.5	99.5	99.8	99.8	99.8	100.0
17 years	26.1	68.9	82.2	93.0	96.0	97.0	97.6	98.8	99.4	100.0	100.0	100.0	100.0
Boys													
12-17 years	23.4	63.5	78.8	89.6	94.2	96.1	97.3	98.3	99.2	99.6	99.7	99.9	100.0
12 years	17.4	58.0	74.8	87.6	94.0	96.0	96.7	98.6	99.7	99.9	99.9	99.9	100.0
13 years	16.6	57.8	77.4	88.1	92.9	94.4	96.6	97.5	99.6	99.9	99.9	99.9	100.0
14 years	19.1	61.1	77.1	87.5	92.9	95.4	97.7	98.0	98.4	98.8	99.2	100.0	100.0
15 years	26.7	63.4	77.6	89.8	93.8	96.6	98.0	98.9	99.5	99.7	99.7	100.0	100.0
16 years	28.8	69.6	83.1	91.4	95.3	97.1	97.5	98.6	99.2	99.6	99.6	99.6	100.0
17 years	33.2	73.0	84.0	94.1	96.7	97.6	97.9	98.7	99.4	100.0	100.0	100.0	100.0
Girls													
12-17 years	13.9	54.4	74.2	87.1	92.5	94.1	96.2	97.6	99.1	99.6	99.9	100.0	100.0
12 years	9.2	45.8	65.9	81.1	89.4	91.7	94.9	96.4	98.6	99.2	99.8	100.0	100.0
13 years	11.1	49.0	70.2	83.5	90.9	92.5	95.1	96.8	98.7	99.2	99.7	100.0	100.0
14 years	15.7	57.2	76.0	87.8	92.3	93.4	95.5	97.2	98.9	99.7	100.0	100.0	100.0
15 years	14.6	54.8	76.1	88.5	92.9	94.4	97.0	98.2	99.4	99.5	99.7	100.0	100.0
16 years	14.6	56.7	77.9	90.9	94.7	96.8	97.9	98.5	99.8	100.0	100.0	100.0	100.0
17 years	19.1	65.3	80.9	92.3	95.6	96.7	97.5	99.1	99.5	100.0	100.0	100.0	100.0

Table 10. Percent of youths of 12-17 years reaching specified acuity levels for each acuity measure, by race: United States, 1966-70

Acuity measures and race	Visual angle												
	0.60 or less	0.75	0.85	1.00	1.25	1.50	2.00	2.50	3.50	5.00	10.00	20.00	More than 20.00
Uncorrected distance	Percent of youths												
Binocular													
White	15.4	31.7	13.3	8.8	4.6	2.6	2.8	2.5	5.2	3.6	5.4	3.2	0.9
Negro	16.4	33.8	15.8	11.6	6.0	2.1	3.0	2.3	3.5	2.1	1.8	1.1	0.5
Better monocular													
White	5.7	28.3	15.9	13.3	6.7	3.0	3.4	3.0	4.8	3.6	6.5	4.2	1.6
Negro	5.2	25.9	18.7	16.7	10.3	5.0	4.6	1.9	3.0	3.5	2.8	1.6	0.8
Right eye													
White	3.7	21.4	15.7	16.5	7.2	3.4	4.0	3.4	4.8	4.5	7.8	4.6	3.0
Negro	3.4	19.5	16.8	19.2	12.3	6.1	4.5	3.6	4.1	3.8	3.6	1.9	1.2
Left eye													
White	3.3	23.0	15.4	13.8	8.8	4.0	4.0	3.4	4.8	4.2	8.1	4.5	2.7
Negro	3.4	19.9	17.6	17.9	11.8	6.3	6.2	2.8	3.2	4.1	3.5	1.5	1.8
Uncorrected near													
Binocular													
White	5.6	39.7	23.7	14.9	5.6	2.2	2.0	1.1	1.5	1.4	1.5	0.6	0.2
Negro	7.5	36.7	26.2	12.8	7.7	2.0	2.6	1.3	0.8	0.9	0.8	0.3	0.4
Better monocular													
White	1.9	29.4	25.0	24.1	8.2	2.3	2.2	1.3	1.5	1.5	1.8	0.6	0.2
Negro	2.1	29.1	23.0	24.4	10.7	3.5	2.3	1.4	0.8	1.0	0.7	0.7	0.3
Right eye													
White	1.4	20.4	26.6	23.0	12.3	3.7	3.0	1.6	2.0	1.9	2.4	0.9	0.8
Negro	1.4	19.0	26.8	22.2	15.1	5.4	3.0	2.2	1.0	1.1	1.3	1.0	0.5
Left eye													
White	0.8	20.3	18.1	31.5	12.8	3.6	2.8	2.0	2.1	2.1	2.3	1.0	0.6
Negro	0.9	21.8	15.4	31.5	14.4	4.2	4.4	2.1	1.5	1.3	1.2	0.6	0.7
Corrected distance													
Binocular													
White	13.4	38.9	19.6	15.9	6.5	2.3	2.0	0.7	0.6	0.1	0.0	-	-
Negro	7.1	25.3	26.8	24.4	7.8	3.0	1.2	1.5	1.4	-	-	1.5	-
Better monocular													
White	6.2	27.5	19.9	25.1	10.1	5.5	2.7	1.4	1.1	0.3	0.2	-	-
Negro	0.6	19.7	19.7	24.7	20.3	5.5	4.5	0.7	1.2	1.6	1.5	-	-
Right eye													
White	2.8	20.8	17.0	29.5	12.2	6.8	4.2	3.1	1.8	0.7	0.5	0.2	0.4
Negro	-	10.9	14.8	28.7	22.7	5.1	6.0	5.3	0.6	2.8	2.2	0.9	-
Left eye													
White	4.8	20.6	18.3	24.4	13.0	7.8	4.4	2.4	2.2	1.0	0.8	0.1	0.2
Negro	0.6	15.5	14.3	27.6	13.6	11.9	6.6	1.6	5.1	0.8	-	-	2.4
"With usual correction"													
Binocular distance													
White	18.9	41.1	17.3	11.6	4.8	1.8	1.5	1.1	1.1	0.4	0.2	0.1	0.1
Negro	17.0	35.3	19.0	13.4	5.7	1.9	2.7	1.7	2.0	0.7	0.1	0.5	-

Table 11. Percent of youths of 12-17 years reaching specified acuity levels for each acuity measure, by region: United States, 1966-70

Acuity measures and region	Visual angle												
	0.60 or less	0.75	0.85	1.00	1.25	1.50	2.00	2.50	3.50	5.00	10.00	20.00	More than 20.00
Uncorrected distance	Percent of youths												
Binocular													
Northeast	12.3	33.6	13.5	9.8	4.8	2.9	3.4	2.2	5.0	3.6	4.8	3.2	0.9
Midwest	13.5	29.6	12.5	10.0	5.2	2.4	2.8	3.2	5.8	4.3	6.1	3.6	1.0
South	17.1	34.8	16.0	8.5	4.5	2.6	2.6	2.0	3.8	2.3	3.2	2.0	0.6
West	19.0	30.6	12.9	8.2	4.7	2.1	2.6	2.4	5.0	3.3	5.2	2.8	1.2
Better monocular													
Northeast	4.4	26.5	17.7	13.9	6.7	3.3	3.7	3.8	4.7	3.7	6.4	3.8	1.4
Midwest	4.7	26.5	14.6	13.1	7.6	3.4	3.5	2.9	5.8	3.8	7.4	4.9	1.8
South	6.3	30.6	17.6	14.1	8.3	3.0	3.9	2.1	3.1	3.4	4.3	2.3	1.0
West	7.0	28.3	15.6	13.8	6.4	3.2	3.3	2.5	4.3	3.5	6.0	4.3	1.8
Uncorrected near													
Binocular													
Northeast	4.8	35.2	26.5	14.9	7.4	2.2	2.0	0.9	2.0	1.5	1.7	0.5	0.4
Midwest	5.1	38.7	23.1	15.6	5.9	2.4	2.3	1.3	1.4	1.3	1.7	1.0	0.2
South	5.5	37.8	26.7	14.7	5.7	2.7	1.8	0.8	1.4	1.0	1.5	0.2	0.2
West	8.1	45.1	20.4	12.8	4.7	1.5	2.0	1.5	0.8	1.4	1.1	0.4	0.2
Better monocular													
Northeast	1.2	25.7	26.9	23.6	9.9	2.6	2.3	1.1	2.0	1.7	2.0	0.7	0.3
Midwest	1.7	28.1	23.4	25.5	8.6	2.8	2.2	1.5	1.7	1.3	2.0	0.8	0.4
South	1.5	29.7	24.0	25.1	9.5	2.7	2.3	0.8	1.2	1.0	1.6	0.5	0.1
West	3.1	33.3	24.8	21.9	6.5	1.8	2.2	2.0	0.9	1.6	1.3	0.5	0.1
Corrected distance													
Binocular													
Northeast	9.1	38.9	18.5	18.7	8.5	2.1	2.4	0.8	0.4	0.2	0.2	0.2	-
Midwest	14.0	39.3	17.9	16.8	5.4	2.8	2.0	1.0	0.6	0.2	-	-	-
South	9.7	35.0	22.5	18.2	6.1	3.1	2.9	1.2	1.0	-	-	0.3	-
West	17.9	37.7	22.6	12.1	6.9	1.4	0.7	-	0.7	-	-	-	-
Better monocular													
Northeast	3.4	23.8	22.5	26.6	11.1	6.2	2.7	2.0	0.8	0.4	0.5	-	-
Midwest	6.9	27.9	18.0	24.7	10.2	6.4	2.5	1.5	1.4	0.3	0.2	-	-
South	4.1	26.4	15.4	24.2	17.5	4.0	3.8	2.2	1.6	0.3	0.5	-	-
West	8.0	29.3	23.2	24.1	6.6	5.2	2.6	-	0.6	0.4	-	-	-
"With usual correction"													
Binocular distance													
Northeast	14.7	42.9	17.6	13.2	5.5	1.8	2.0	0.7	0.9	0.3	0.2	0.2	0.0
Midwest	17.7	40.4	16.7	13.0	5.0	1.8	1.9	1.4	1.3	0.3	0.2	0.2	0.1
South	18.6	40.0	18.8	10.8	4.3	2.3	1.8	1.4	1.4	0.4	0.0	0.2	0.0
West	23.3	38.6	17.2	10.3	5.2	1.2	1.0	1.2	1.1	0.6	0.2	-	0.1

Table 12. Percent of youths of 12-17 years reaching specified acuity levels for each acuity measure, by annual family income: United States, 1966-70

Acuity measures and annual family income	Visual angle												
	0.60 or less	0.75	0.85	1.00	1.25	1.50	2.00	2.50	3.50	5.00	10.00	20.00	More than 20.00
Uncorrected distance	Percent of youths												
Binocular													
Less than $3,000---	13.2	35.0	18.1	10.3	5.3	3.8	2.5	2.3	3.9	1.1	2.5	1.9	0.1
$3,000-$4,999------	17.2	29.8	15.6	9.9	4.8	2.2	3.8	1.7	4.0	3.4	4.2	2.8	0.6
$5,000-$6,999------	14.8	33.0	14.2	7.4	5.2	1.5	2.6	3.8	6.3	3.6	5.3	1.7	0.6
$7,000-$9,999------	14.8	32.0	13.8	8.8	5.3	2.6	2.5	2.6	4.7	3.9	5.1	2.6	1.3
$10,000-$14,999----	15.1	30.3	11.2	9.5	4.1	2.4	2.3	2.6	5.4	4.5	6.5	4.9	1.2
$15,000 or more----	20.3	30.0	9.8	8.4	4.4	2.6	4.0	2.1	4.3	3.4	5.5	3.7	1.5
Better monocular													
Less than $3,000---	6.1	26.1	18.2	17.8	8.6	4.4	4.5	2.3	3.6	3.2	2.6	1.7	0.9
$3,000-$4,999------	5.3	28.2	15.4	14.3	9.6	3.2	5.2	1.9	3.4	3.4	5.2	3.9	1.0
$5,000-$6,999------	5.1	26.3	18.6	13.4	6.8	2.8	3.1	3.0	6.4	4.0	6.5	2.9	1.1
$7,000-$9,999------	5.0	29.9	15.1	13.6	6.7	3.0	3.5	2.8	3.9	3.8	7.0	4.0	1.7
$10,000-$14,999----	5.8	27.0	14.1	12.7	7.2	2.7	2.4	3.1	4.7	4.4	7.9	5.6	2.4
$15,000 or more-----	7.2	31.1	13.6	11.3	5.6	3.1	3.6	3.8	4.8	2.2	7.3	4.2	2.2
Uncorrected near													
Binocular													
Less than $3,000---	4.8	38.8	25.3	16.1	5.9	2.4	2.6	1.5	0.6	0.8	0.8	0.3	0.1
$3,000-$4,999------	4.9	34.5	28.2	15.1	7.8	2.2	2.1	1.0	0.7	1.3	1.7	0.3	0.2
$5,000-$6,999------	5.7	37.6	26.0	14.6	5.2	2.1	2.5	.4	1.6	1.4	1.4	0.3	0.2
$7,000-$9,999------	7.4	38.5	23.8	14.7	5.2	2.3	2.2	1.4	1.0	1.2	1.4	0.8	0.1
$10,000-$14,999----	6.1	40.5	20.7	14.7	6.2	2.4	1.7	0.9	2.3	1.6	1.9	0.6	0.4
$15,000 or more----	5.6	47.4	21.0	11.0	5.0	1.7	1.3	1.1	1.8	1.2	2.0	0.9	-
Better monocular													
Less than $3,000---	2.0	25.6	25.2	26.9	9.6	2.9	3.1	1.2	1.1	1.4	0.7	0.3	-
$3,000-$4,999------	1.3	26.9	23.3	27.1	10.4	2.7	2.2	0.8	1.3	1.1	2.1	0.6	0.2
$5,000-$6,999------	1.6	27.5	24.1	26.0	9.6	2.0	2.1	1.7	1.8	1.5	1.6	0.3	0.2
$7,000-$9,999------	1.9	30.1	25.2	24.2	6.7	3.1	2.0	1.7	1.3	1.2	1.5	0.9	0.2
$10,000-$14,999----	2.2	30.5	22.4	23.4	8.6	2.6	2.0	1.6	1.8	1.6	2.2	0.8	0.3
$15,000 or more----	2.2	35.3	27.8	17.0	6.4	1.7	2.4	1.0	1.2	1.6	2.5	0.5	0.4
Corrected distance													
Binocular													
Less than $3,000---	11.4	23.2	27.8	20.7	9.1	2.4	3.8	0.6	1.0	-	-	-	-
$3,000-$4,999------	9.7	32.5	23.0	17.6	9.9	2.0	1.6	2.0	1.7	-	-	-	-
$5,000-$6,999------	11.8	35.1	19.2	20.6	6.9	2.0	2.6	0.8	0.4	-	0.3	0.3	-
$7,000-$9,999------	14.4	41.5	19.0	13.1	7.4	1.8	1.8	0.6	0.2	0.2	-	-	-
$10,000-$14,999----	14.2	39.8	18.5	16.7	4.6	2.3	1.8	0.8	1.0	0.3	-	-	-
$15,000 or more----	12.4	46.0	19.1	12.4	4.9	3.7	1.1	-	0.4	-	-	-	-
Better monocular													
Less than $3,000---	4.2	18.4	20.7	26.6	14.4	6.6	5.3	-	1.3	1.9	0.6	-	-
$3,000-$4,999------	2.5	23.9	18.3	23.5	16.0	8.4	3.4	1.3	1.8	0.9	-	-	-
$5,000-$6,999------	4.7	28.5	14.4	26.9	13.4	6.2	2.7	1.7	0.9	-	0.6	-	-
$7,000-$9,999------	7.0	28.0	23.2	23.0	8.2	4.9	2.6	2.3	0.6	0.2	-	-	-
$10,000-$14,999----	7.5	27.9	19.2	25.6	9.3	4.6	2.8	1.0	1.5	0.2	0.4	-	-
$15,000 or more----	4.6	33.3	22.0	21.0	9.5	6.6	1.5	0.4	0.7	0.4	-	-	-
"With usual correction"													
Binocular distance													
Less than $3,000---	14.8	37.5	21.0	11.7	5.7	2.9	2.0	1.9	2.0	0.2	0.1	0.2	-
$3,000-$4,999------	18.9	35.5	19.6	12.5	5.6	1.5	2.0	1.2	1.9	0.6	0.4	0.3	0.0
$5,000-$6,999------	17.1	40.4	18.1	11.2	5.6	0.8	2.6	1.7	1.3	0.7	0.3	0.2	-
$7,000-$9,999------	18.7	41.9	17.4	11.1	5.1	1.7	1.5	1.2	0.7	0.3	0.2	0.1	0.1
$10,000-$14,999----	19.7	42.2	16.0	13.0	4.0	1.4	1.3	0.9	1.0	0.3	0.1	0.1	-
$15,000 or more----	23.9	42.3	14.1	10.8	4.3	2.1	1.0	0.6	0.3	0.4	-	-	0.2

APPENDIX I

STATISTICAL NOTES

The Survey Design

The sample design for the first three programs of the Health Examination Survey, Cycles I-III, has been essentially similar in that each has been a multistage, stratified probability sample of clusters of households in land-based segments. The successive elements for this sample design are primary sampling unit, census enumeration district, segment (a cluster of households), eligible person, and finally the sample person.

The 40 sample areas and the segments utilized in the design of Cycle III were the same as those in Cycle II. Previous reports describe in detail the sample design used for Cycle II and in addition discuss the problems and considerations given to other types of sampling frames, cluster versus random sampling, and whether or not to control the selection of siblings.[4,5]

Requirements and limitations placed on the design for Cycle III, similar to those for children in Cycle II, were that:

1. The target population be defined as the civilian noninstitutional population of the United States, including Alaska and Hawaii, between the ages of 12 and 17 years for Cycle III, with the special exclusion of children residing on reservation lands of the American Indians. The latter exclusion was due to operational problems encountered on these lands in Cycle I.
2. The time period of data collection be limited to about 3 years for each cycle and the length of the individual examination within the specially constructed mobile examination center be between 2 and 3 hours.
3. Ancillary data be collected on specially designed household, medical history, and school questionnaires and from birth certificate copies.
4. Examination objectives be primarily related to factors of physical and intellectual growth and development.
5. The sample be sufficiently large to yield reliable findings within broad geographic regions and population density groups as well as age, sex, and limited socioeconomic groups for the total sample.

The sample was drawn jointly with the U.S. Bureau of the Census, starting with the 1960 decennial census list of addresses and the nearly 1,900 primary sampling units (PSU's) into which the entire United States was divided. Each PSU is either a standard metropolitan statistical area (SMSA), a county, or a group of two or three contiguous counties. These PSU's were grouped into 40 strata, each stratum having an average size of about 4.5 million persons, in such a manner as to maximize the degree of homogeneity within strata with regard to the population size of the PSU's, degree of urbanization, geographic proximity, and degree of industrialization. The 40 strata were then classified into 4 broad geographic regions of 10 strata each and then within each region cross-classified by four population density classes and classes of rate of population change from 1950 to 1960. Using a modified Goodman-Kish controlled-selection technique, one PSU was drawn from each of the 40 strata.

Further stages of sampling within PSU's required first the selection of census enumeration districts (ED's). The ED's are small well-defined areas of about 250 housing units into which the entire Nation was divided for the 1960 population census. Each ED was assigned a "measure of size" equal to the rounded whole number resulting from a "division by nine" of the number of children aged 5-9 in the ED at the time of the 1960 census. A sample of 20 ED's in the sample PSU were selected by systematic sampling with each ED having a probability of selection proportional to the population of children 5-9 years at the time of the 1960 census. A further random selection by size of segments (smaller clusters of housing units) within each ED was then made.

Because of the 3-year time interval between Cycle II and Cycle III, the Cycle III frame had to be supplemented for new construction and to compensate for segments where housing was partially or totally demolished to make room for highway construction or urban redevelopment.

Advanced planning for the examinations at the various locations or stands provided for about 17 days

of examinations, which limited the number of examinees per location to approximately 200. When the number of eligible youth in the sample drawn for a particular location exceeded this number, subsampling was done by deleting from the master list of eligible youth (ordered by segment, household order within segment, and age within household) every nth name on the list starting with the yth name, y being a number between 1 and n selected randomly and n being the extent of oversampling in the original draw.

In Cycle III, as in Cycle II, twins who were deleted in the sample selection were also scheduled for examination, time permitting, as were youth deleted from the Cycle III sample who had been examined in Cycle II.

The sample was selected in Cycle III, as it had been in Cycle II, so as to contain the correct proportion of youth from families having only one eligible youth, two eligible youth, and so on to be representative of the total target population. However, since households were one of the elements in the sample frame, the number of related youth in the resultant sample is greater than would come from a design which sampled youth 12-17 years without regard to household. The resultant estimated mean measurements or rates should be unbiased, but their sampling variability will be somewhat greater than those from a more costly, time-consuming systematic sample design in which every kth youth would be selected.

The total probability sample for Cycle III included 7,514 youths representative of the approximately 22.7 million noninstitutionalized United States youths of 12-17 years. The sample contained youth from 25 different States and approximately 1,000 in each single year of age.

The response rate in Cycle III was 90 percent, with 6,768 youth examined out of the total sample. These examinees were closely representative of those in the samples as well as the population from which the samples were drawn with respect to age, sex, race, region, population density, and population growth in area of residence. Hence it appears unlikely that nonresponse could bias the findings appreciably.

Measures used to control the quality of the data from these surveys have been cited previously; [5,14] those additional measures specifically related to the particular examinations, tests, or measurements are outlined in the analytic reports describing and presenting the respective initial findings. As indicated, each of the five dentists employed during the youth cycle was given training and practice in vision testing techniques throughtout his employment to insure the consistency of test results. As may be seen in table I, the proportion of youth rated as normal or better, mildly defective, and moderately to severely defective showed essentially no differences that might be attributable to the examiners when the age and sex differences among the examinees at the various locations was removed.

Reliability

While measurement processes in the surveys were carefully standardized and closely controlled, the correspondence between the real world and survey results cannot be expected to be exact. Survey data are imperfect for three major reasons: (1) results are subject to sampling error, (2) the actual conduct of a survey never agrees perfectly with the design, and (3) the measurement processes themselves are inexact even though standardized and controlled.

The report which describes the plan and operation of Cycle III [5] gives in detail the faithfulness with which the sampling design was carried out.

Data recorded for each sample youth are inflated in the estimation process to characterize the larger universe of which the sample youth is representative. The weights used in this inflation process are a product of the reciprocal of the probability of selecting the youth, an adjustment for nonresponse cases, and a poststratified ratio adjustment which increases precision by bringing survey results into closer alignment with known United States population figures by color and sex within single years of age 12 through 17 for the youth survey.

In the third cycle of the Health Examination Survey (as for the children in Cycle II) the samples were the result of three principal stages of selection—the single PSU from each stratum, the 20 segments from each sample PSU, and the sample youth from the eligible persons. The probability of selecting an individual youth is the product of the probability of selection at each stage.

Since the strata are roughly equal in population size and a nearly equal number of sample youth were examined in each of the sample PSU's, the sample design is essentially self-weighting with respect to the target population; that is, each youth 12 through 17 years had about the same probability of being drawn into the respective samples.

The adjustment upward for nonresponse is intended to minimize the impact of nonresponse on final estimates by imputing to nonrespondents the characteristics of "similar" respondents. Here "similar" respondents were judged to be examined youth in a sample PSU having the same age (in years) and sex as youth not examined in that sample PSU.

The poststratified ratio adjustment used in the third cycle achieved most of the gains in precision which would have been attained if the sample had been drawn from a population stratified by age, color, and sex and makes the final sample estimates of population agree exactly with independent controls prepared by the Bureau of the Census for the U.S. noninstitu-

Table I. Number of examinees of 12-17 years and percent observed and expected, reaching or exceeding specified acuity levels for uncorrected binocular distance vision, by examiner: Health Examination Survey, 1966-70

Acuity level and sex	Examiner						
	1[a]	2[a]	3	4	5	6	7
	Number of examinees						
Both sexes	1	38	476	1,817	1,856	1,446	1,134
Boys	1	22	255	940	958	739	630
Girls	0	16	221	877	898	707	504
20/20 OR BETTER							
	Percent of examinees						
Both sexes							
Actual	*	*	67.2	70.6	71.6	70.0	72.0
Expected[b]	*	*	67.4	70.6	71.5	70.0	72.0
Boys							
Actual	*	*	73.3	75.2	75.0	73.2	74.4
Expected[b]	*	*	73.6	75.2	74.9	73.1	74.4
Girls							
Actual	*	*	60.2	65.6	67.9	66.6	69.0
Expected[b]	*	*	60.9	65.6	68.0	67.0	69.0
20/25 TO 20/50							
Both sexes							
Actual	*	*	15.1	12.7	12.0	12.9	12.8
Expected[b]	*	*	14.9	12.7	12.0	12.9	12.7
Boys							
Actual	*	*	12.2	11.0	10.6	11.5	11.6
Expected[b]	*	*	11.9	11.0	10.7	11.6	11.5
Girls							
Actual	*	*	18.6	14.5	13.5	14.3	14.3
Expected[b]	*	*	18.2	14.4	13.4	14.1	14.2
20/70 OR POORER							
Both sexes							
Actual	*	*	17.6	16.8	16.4	17.2	15.2
Expected[b]	*	*	17.7	16.8	16.4	17.1	15.2
Boys							
Actual	*	*	14.5	13.8	14.4	15.3	14.0
Expected[b]	*	*	14.5	13.8	14.4	15.3	14.0
Girls							
Actual	*	*	21.3	20.0	18.6	19.1	16.7
Expected[b]	*	*	20.9	19.9	18.6	18.9	16.8

[a]Dental advisors who performed tests only in emergencies when the regular examiner was absent.
[b]With the effect of differences in the age-sex distributions among the various examinee groups removed by an indirect adjustment.

tional population as of March 9, 1968 (approximate mid-survey point for Cycle III), by color and sex for each single year of age 12-17. The weight of every responding sample youth in each of the 24 age, color, and sex classes is adjusted upward or downward so that the weighted total within the class equals the independent population control for each survey.

In addition to youth not examined at all, there were some whose examination was incomplete in one procedure or another. The extent of missing data for the part of the examination and selected items in the medical history relevant to this report is shown in table II.

Table II. Number of examinees and extent of visual acuity tests missed, by age: Health Examination Survey, 1966-70

Examinee status and acuity measure	12-17 years	12 years	13 years	14 years	15 years	16 years	17 years
	Number of examinees						
All examinees	6,768	1,190	1,208	1,204	1,116	1,092	958
Examinee not tested at all	10	0	4	1	1	2	2
Examinee missed only some tests							
Uncorrected distance:							
Right eye	19	3	5	4	3	2	2
Left eye	18	5	2	4	3	2	2
Binocular	18	4	2	5	4	2	1
Uncorrected near:							
Right eye	21	4	5	5	4	2	1
Left eye	19	4	2	3	5	2	3
Binocular	27	6	3	4	7	4	3
Corrected distance:							
Right eye	32	7	5	11	5	2	2
Left eye	31	7	4	10	5	3	2
Binocular	37	11	4	10	5	4	3

Sampling and Measurement Error

In the present report, reference has been made to efforts to minimize bias and variability of measurement techniques.

The probability design of the survey makes possible the calculation of sampling errors. The sampling error is used here to determine how imprecise the survey test results may be because they come from a sample rather than from the measurements of all elements in the universe.

The estimation of sampling errors for a study of the type of the Health Examination Survey is difficult for at least three reasons: (1) measurement error and "pure" sampling error are confounded in the data—it is not easy to find a procedure which will either completely include both or treat one or the other separately, (2) the survey design and estimation procedure are complex and accordingly require computationally involved techniques for the calculation of variances, and (3) from the survey are coming thousands of statistics, many for subclasses of the population for which there are a small number of cases. Estimates of sampling error are obtained from the sample data and are themselves subject to sampling error which may be large when the number of cases in a cell is small or even occasionally when the number of cases is substantial.

Estimates of approximate sampling variability for selected statistics used in this report are included in the detailed tables. These estimates have been prepared by a replication technique which yields overall variability through observation of variability among random subsamples of the total sample.[15] The method reflects both "pure" sampling variance and a part of the measurement variance.

In accordance with usual practice, the interval estimate for any statistic may be considered the range within one standard error of the tabulated statistic with 68-percent confidence or the range within two standard errors of the tabulated statistic with 95-percent confidence. The latter is used as the level of significance in this report.

An approximation of the standard error of a difference $d = x - y$ of two statistics x and y is given by the formula $S_d = (S_x^2 + S_y^2)^{1/2}$ where S_x and S_y are the sampling errors, respectively, of x and y. Of course, where the two groups or measures are positively or negatively correlated, this will give an overestimate or underestimate, respectively, of the actual standard eror.

Small Numbers

In some tables magnitudes are shown for cells for which the sample size is so small that the sampling error may be several times as great as the statistic itself. Obviously in such instances the statistic has no meaning in itself except to indicate that the true quantity is small. Such numbers, if shown, have been included in the belief that they may help to convey an impression of the overall story of the table.

———— ○○○ ————

APPENDIX II

DEMOGRAPHIC AND SOCIOECONOMIC TERMS

Age.—The age recorded for each youth was the age at last birthday on the date of examination. The age criterion for inclusion in the sample used in this survey was defined in terms of age at time of interview. Since the examination usually took place 2 to 4 weeks after the interview, some of those who were 17 years old at the time of interview became 18 years old by the time of examination. There were 23 such cases. In the adjustment and weighting procedures used to produce national estimates, these 23 were included in the 17-year group.

Race.—Race was recorded as "white," "Negro," or "other races." The last category included American Indians, Chinese, Japanese, and all races other than white or Negro. Mexican persons were included with "white" unless definitely known to be American Indian or of another race. Negroes and persons of mixed Negro and other parentage were recorded as "Negro."

Geographic Region.—For purposes of stratification the United States was divided into four geographic regions of approximately equal population. These regions, which correspond closely to those used by the U.S. Bureau of the Census, were as follows:

Region	*States Included*
Northeast	Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, and Pennsylvania
Midwest	Ohio, Illinois, Indiana, Michigan, Wisconsin, Minnesota, Iowa, and Missouri
South	Delaware, Maryland, District of Columbia, West Virginia, Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Arkansas
West	Washington, Oregon, California, Nevada, New Mexico, Arizona, Texas, Oklahoma, Kansas, Nebraska, North Dakota, South Dakota, Idaho, Utah, Colorado, Montana, Wyoming, Alaska, and Hawaii

Urban and rural areas.—The definition of urban and rural areas was the same as that used in the 1960 census. According to this definition, the urban population was comprised of all persons living in (a) places of 2,500 inhabitants or more incorporated as cities, boroughs, villages, and towns (except towns in New England, New York, and Wisconsin); (b) the densely settled urban fringe, whether incorporated or unincorporated, of urbanized areas; (c) towns in New England and townships in New Jersey and Pennsylvania which contained no incorporated municipalities as subdivisions and had either 2,500 inhabitants or more, or a population of 2,500 to 25,000 and a density of 1,500 persons or more per square mile; (d) counties in States other than the New England States, New Jersey, and Pennsylvania that had no incorporated municipalities within their boundaries and had a density of 1,500 persons or more per square mile; and (e) unincorporated places of 2,500 inhabitants or more not included in any urban fringe. The remaining population was classified as rural.

Urban areas were further classified by population size for places within urbanized areas and other urban places outside urbanized areas.

Family income.—The income recorded was the total income received during the past 12 months by the head of the household and all other household members related to the head by blood, marriage, or adoption. This income was the gross cash income (excluding pay in kind) except in the case of a family with its own farm or business, in which case net income was recorded.

Parent.—A parent was the natural parent or, in the case of adoption, the legal parent of the youth.

Guardian.—A guardian was responsible for the care and supervision of the youth. He (or she) did not have to be the legal guardian to be considered the guardian for this survey. A guardianship could only exist when the parent(s) of the youth did not reside within the sample household.

Head of household.—Only one person in each household was designated as the "head." He (or she) was the person who was regarded as the "head" by the members of the household. In most cases the head was the chief breadwinner of the family although this was not always true. In some cases the head was the parent of the chief earner or the only adult member of the household.

APPENDIX III

TARGET SPECIFICATIONS FOR VISION TESTING

Scoring Sheets, for Master Ortho-Rater Plates

HEALTH EXAMINATION SURVEY—III

Wears glasses for test: 1 ☐

Wears contact lenses for test: 2 ☐

Wears neither for test: 3 ☐

DISTANCE VISION—WITHOUT CORRECTION
(same test given with own correction)

VISION TESTS

Check tests given first. ☐ For ☐ Near (Odd numbers distance first; even numbers near first)

2. MONOCULAR DISTANCE—SMALL*

Line	Right eye	Score (Check)	Left eye	Score
5	VHDNS OZKRC	___ 50	CDZNO KSRVH	___ 50
6	DVZNC SRHKO	___ 40	CNRKH ZVSDO	___ 40
7	KNZCO SRDHV	___ 30	DVHCK OZNSR	___ 30
8	KNDRS ZVCOH	___ 25	CDKRO SZVNH	___ 25
9	VZCHD KNRSO	___ 20	CVHSZ ORKDN	___ 20
10	KZSVN HCRDO	___ 17	DNVHS OKRCZ	___ 17
11	RCSNV KDHOZ	___ 15	ZHODC SVNKR	___ 15
12	ROKHZ NSCVD	___ 12	KHOZD CSNVR	___ 12

3. MONOCULAR DISTANCE—LARGE* *(Omit if score on Dial 2)*

Line	Right eye	Score	Left eye	Score
1	SDK	___400	VNC	___400
2 / 2	RCSZO / KNHDV	___200	OZNKS / DRHCV	___200
3	HNZOS KRCVD	___100	RZOHC	KSNDV___100
4	ZHODC SVNKR	___ 70	RKNCZ	HSDVO___ 70

CODE _____ CODE _____

3A. BINOCULAR DISTANCE—SMALL*

Line	Score
5	OSDNH VKZCR ___ 50
6	RHZCD OSVKN ___ 40
7	SVNHO KCRDZ ___ 30
8	RHSCK OZDVN ___ 25
9	OZRVN HSCKD ___ 20
10	DRHVN ZSKCO ___ 17
11	OSKCV RZHDN ___ 15
12	SKHDN OCVRZ ___ 12

4A. BINOCULAR DISTANCE—LARGE* *(Omit if score on Dial 3A)*

Line	Score
1	KDS ___400
2 / 2	ZSKCO / VRHDN ___ 200
3	ZNSKH VDRCO ___ 100
4	OZCRH NSKDV ___ 70

Code _____

*Diagonal line through each letter missed; horizontal line through sections of line not attempted and through top full line not attempted.

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SAMPLE NO. (1-5)

NEAR VISION—WITHOUT CORRECTION
(same test given with own correction)

7. MONOCULAR NEAR—SMALL*

Line	Right eye	Score (Check)	Left eye	Score
5	CVRZS DKHNO	___ 50	ZKCRV OHSDN	___ 50
6	VZKCO HRSDN	___ 40	SDKVO ZRHNC	___ 40
7	HSZKN OVCDR	___ 30	DHZRV SOKNC	___ 30
8	OVRHS CNDZK	___ 25	DKOSN RVZCH	___ 25
9	ZHCOR VDNSK	___ 20	RKZVD OSNCH	___ 20
10	RHCVN SDKZO	___ 17	OKSRN DHVCZ	___ 17
11	CNZSR OHKDV	___ 15	VRCHN OZKSD	___ 15
12	ODCNH VRSKZ	___ 12	ROHKS VDNCZ	___ 12

8. MONOCULAR NEAR—LARGE* *(Omit if score on Dial 7)*

Line	Right eye	Score	Left eye	Score
1	NCV	___ 400	DSK	___ 400
2	HNRCD	___ 200	CRSZO	___ 200
2	VOSZK		NDVHK	
3	NDOCV RSZKH	___ 100	OKZHS NCVRD	___ 100
4	VRCNZ OSDHK	___ 70	RCOVN DHKSZ	___ 70

CODE _____ CODE _____

9. BINOCULAR NEAR—SMALL*

Line		Score
5	OCVKR ZNSDH	___ 50
6	ZHOCV NDRKS	___ 40
7	SDOVK HRNZC	___ 30
8	DNHKO ZSRVC	___ 25
9	DSVKH ZNOCR	___ 20
10	NZHKO RCVDS	___ 17
11	SNCZO RKVHD	___ 15
12	DHNVO SCZKR	___ 12

NS5. BINOCULAR NEAR—LARGE* *(Omit if score on Dial 9)*

Line		Score
1	NVC	___ 400
2	CZHSN	___ 200
2	DKORV	
3	KSDVO NHZCR	___ 100
4	VZOCS HRNKD	___ 70

CODE _____

*Diagonal line through each letter missed; horizontal line through sections of line not attempted and through top full line not attempted.

Specifications for Survey Targets — Optotypes Size, Optotypes Per Lines

Snellen ratios for optotype size		Number of optotypes per line	
Master Ortho-rater		Master Ortho-rater	
Distance	Near	Distance	Near
20/400	13/260	3	3
20/200	13/130	10	10
- - -		- - -	- - -
- - -		- - -	- - -
20/100	13/65	10	10
- - -		- - -	- - -
20/70	13/45.5	10	10
- - -		- - -	- - -
20/50	13/32.5	10	10
20/40	13/26	10	10
20/30	13/19.5	10	10
20/25	13/16.25	10	10
20/20	13/13	10	10
20/17	13/11.05	10	10
20/15	13/9.75	10	10
20/12	13/7.8	10	10

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